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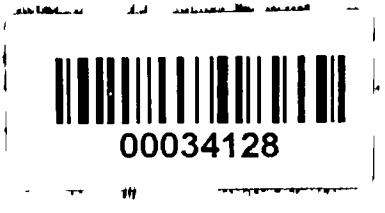

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PREFACE.

THE following analysis of the prevailing geological opinions of the day would not have been attempted, had it not been thought that the question cannot long rest where it now stands. Neither would the author have set himself against an array of high authorities on the science, had he not been equally aware of the conflicting and unstable nature of opinion, even among those authorities, on the subject at issue. To any one who has watched the progress of theoretical geology for the last few years,—without even reverting to the speculations of the last century,—where opinion has so often vacillated and changed on the subject, and where so many hasty conclusions have been formed, that scarcely has an author his speculations half through the press, when the last part must

be written as a caveat or contradiction of the first,—it will not be deemed a high degree of presumption to attempt an analysis of the points of discussion, and to place these in such a shape as may enable the general inquirer to comprehend the import and bearing of the whole question.

In a work recently published for the use of students, where the facts of geology alone are given, I have endeavoured to illustrate the practicability of teaching all that is really important in the science, apart from theoretical views. That work having already had a rapid circulation, I have in the present endeavoured to complete my original plan, by giving an analysis of those facts as they bear upon theoretical and historical views of the past condition of the earth. I am well aware, however, that the execution of this task is very incomplete, and could have wished that some one, having more extensive means of information, and more leisure from the anxieties of daily avocations, had undertaken it.

I must also here, in the outset, state, that I may be reckoned by some not an unpreju-

diced judge of the questions before me; for, entertaining such a belief in the Sacred Writings as makes me confident that their general import was intended to be as readily understood by the mass of mankind as by the critical inquirer, I am disposed to give implicit credence to the narrative of creation, to the whole extent that it goes; and wherever discrepancies present themselves, to await the issue of the approximation of geological knowledge to the sacred history, instead of attempting to torture this latter into a conformity with the former. I am not aware, however, that in these pages this bias has materially influenced the impartiality of my statements, or swayed, in any degree, my conclusions from facts.

The few practical illustrations which I have appended in the Notes are necessarily of a local nature, consisting of those which come more immediately under my inspection; and they are given more with a view of shewing, that if the labours of research were sometimes directed to illustrate how far the fossils of the great leading formations may coincide instead of differ, the results would perhaps

accumulate as much on the one side as they hitherto appear to have done on the other.

I have also attempted to shew, that the diluvial covering of the different strata has not yet received from geologists that attention which its importance, in a theoretical view, deserves.

To those who have ample leisure and other concomitant opportunities for such pursuits, there is not a field of greater interest presented to the exertions of the philosopher than some of these geological investigations afford; and few where he can be more harmlessly, or, as regards the promotion of the arts and conveniences of life, perhaps more usefully employed.

21, Forth Street,
January, 1838.

CONTENTS.

PART I.

GEOLOGICAL PHENOMENA SUPPOSED TO INDICATE THE AGE OF THE EARTH.

Sect.		Page
I.	General View of the Earth's Strata and their Aggregate Thickness,	11
II.	Proofs of the Rapid Accumulation of the Sedimentary Matter at present forming,	20
III.	Different Formations may be contemporary,	31
IV.	Some Formations have been suddenly deposited,	36
V.	Successive Series of Organic Remains in the different Formations,	41
VI.	Change of Temperature,	
VII.	Operations at present in progress,	61

PART II.

GEOLOGICAL PHENOMENA COMPARED WITH THE MOSAICAL RECORD.

I.	The Mosaical and Geological views of Creation,	71
II.	Mosaical and Geological views of the Deluge,	87
III.	General Summary,	107

PART III.

SKETCH OF GEOLOGICAL THEORIES.

I.	Early History of Geology,	125
II.	Later Geological Theories,	135

NOTES AND ILLUSTRATIONS.

Note		Page
I.	Niddry Quarry near Edinburgh,	153
II.	Fossil Trees, Craigleith Quarry,	158
III.	Theories of Igneous Rocks,	161
IV.	Successive Creations of Animals, and Linnæan Theory,	162
V.	Edinburgh and Wealden Strata,	166
V.*	List of Fossil Mammalia,	168
VI.	Theory of Change of Temperature,	169
VII.	Commencement of present Epoch,	170
VIII.	Effects of River Currents,	171
IX.	Faber, &c. on Days of Creation,	ib.
X.	Drs Chalmers, Buckland, &c. on a Pre-Adamite World,	180
	Dr Powell on Figurative Interpretations of Moses,	188
XI.	Nebular Cosmogony,	190
XII.	Ruins of Babylon and Nineveh,	193
XIII.	Josephus and Philo on the Deluge,	ib.
XIV.	Drs Fleming, Buckland, and Cuvier on do.	194
XV.	Ancient Chronology,	197

Plate	I. to face	Page 166
	II.	167
	III.	196
	IV.	202

PART I.

GEOLOGICAL PHENOMENA SUPPOSED TO INDICATE THE AGE OF THE EARTH.

" The great branches of the Comparative Geology and Comparative Palæontology, (or study of Fossil Remains,) of distant countries, much as they have recently advanced, have as yet even a still wider interval to pass over than that which they may have already accomplished before they shall have obtained that degree of completeness which alone can qualify them to serve as sound bases in any geological theory."—CONYBEARE—*Geological Report of British Association.*

" While so large a portion of the globe is geologically unexplored—while all the general views which are to extend our classifications satisfactorily from one hemisphere to another, are still unformed—*while the organic fossils of the tropics are almost unknown*, and their general relation to the existing state of things has not even been conjectured,—how can we expect to speculate rightly and securely respecting the history of the whole of our globe? and if geological classification and description are thus imperfect, the knowledge of geological causes is still more so."—WHEWELL'S *History of the Inductive Sciences*, vol. iii. p. 621.

SECTION I.

GENERAL VIEW OF THE EARTH'S STRATA, AND THEIR AGGREGATE THICKNESS.

THE creation of the world, and the planetary system of which it forms a part, is an exercise of the Divine power so utterly beyond the conception of man, that, in speculating upon it, he is glad to throw around the whole the envelopment of infinitude, and filling his imagination with ideas of boundless space and indefinite duration, he endeavours to bring up his mind in some degree commensurate with the subject. It is in this way, perhaps, as well as from that innate love of novelty implanted in the breast, that the prevailing opinions of the present time seem to tend so much to the idea of an extreme antiquity of the globe beyond that definite period within which tradition and common belief has hitherto confined it.

Yet if it be pleasing for the mind to forego the trammels of authority, and, starting with a few striking phenomena, to track creation through a

revolving series of worlds till it is lost in the vague and indistinct boundaries of time; it is a no less singular, and perhaps as sublime, speculation, to think that this earthly scene of things, involving so much that is vast and important both in the moral and physical world, and occupying but a brief moment and a mere point of space in the great theatre of eternity, should yet have these points and limits accurately defined and indicated to the mental intelligences, for whose aid and use they are declared to have been created.

The very nature of the study, too, is such as to have a continual tendency to carry the mind beyond the sober boundaries of facts into the airy regions of hypothesis. For, laying aside the speculations of the cosmogonists, — who have formed worlds out of red hot masses severed from the sun, or from fluid spheres of saturated water, or condensed nebulæ, which had hitherto floated as shapeless flocculi in space, — there is in the study of the visible phenomena of the earth's strata, sufficient of wonderful interest to excite and warm the imagination. The remains of unknown plants and animals, which have been entombed for ages in the hard rocks, and which present themselves only in fragments and disjointed members, yet sufficiently distinct to indicate many kinds of being which no longer have an existence on the earth — the exhumation of skeletons of unknown monsters, and the impressions

of the footmarks of others, which have glided like ghosts from this visible scene, but left indelible marks in our sandstones of their actual existence, at a remote period, on our coasts and marshes,—form a species of exciting antiquarianism, compared to which the relics of Herculanæum and Pompeii are but as a tale of yesterday.

It is from these circumstances that perhaps somewhat exaggerated views have been adopted regarding the size, structure, and relative antiquity of these organic bodies, and from thence that many discordant deductions have been made respecting the formation of the strata in which they have been discovered. We must also recollect that another source of perplexity in investigating the history of these strata is, that only a part is now visible to us; that, in the changes which have taken place on the earth's surface, much, if not the whole, of the original dry land has disappeared, and those portions which come under our inspection have evidently, for a considerable period, formed the bottom of the sea, and the successive layers have been accumulated, in a great measure, from the fragmentary portions or disintegration of earlier formed continents. Thus a very important chain of evidence in determining the earth's antiquity is lost to us. We can only now extend our investigations to—or, at least, geological investigations have only hitherto embraced — those portions of strata

which have been formed successively from older existing strata; the outskirts, as it were, of former continents, which had gradually gone on extending their boundaries into the surrounding ocean.

Hence, facts connected with these circumstances early gave rise to theories of the successive appearance of the various classes and genera of plants and animals on the earth, beginning with the simplest, and ascending gradually to the more complicated; while more enlarged experience has shewn these theories to be quite unfounded. Indeed, reasoning *à priori*, and without regard to the indications presented in the fossiliferous strata, we would be inclined, on a review of the present system of things, to pronounce that the creation of all had been a coincident and simultaneous event. Thus, a general and minute harmony appears to subsist among all parts of nature: the relative proportion of land to water seems to be modified so as to produce the necessary amount of evaporation and rain; the composition of the gases of the atmosphere seems to be regulated by the nice balance of interchange which subsists between the proportion of animal respiration and vegetable absorption, so that the necessary amount of oxygen is not diminished, nor carbonic acid too largely accumulated. Thus, too, every vegetable has its own insects and other animals that feed on it; some peculiar to the root, others to the stem and leaves, while minute

animalcules, mounting along with the juices through the porous vessels, make lodgments for their eggs and their young in the seeds; thus completely identifying themselves with the germination and growth of the plants. Every animal, too, has its own appropriate parasites,—entozoæ, which can live only within the bodies of larger animals, and whose origin and existence seem coeval with, and entirely dependent on, the bodies in which they are lodged.

And if we look beyond our terrestrial globe, we shall find that other links of connection bind it to the great solar system of which it forms a part; where its position, its laws of rotation, and attractive forces, all so intimately adjusted to meet and accommodate those of the other spheres, lead us at once to conclude that all had a simultaneous origin.

The opinions of those geologists who maintain the great antiquity of the earth, are formed from an inspection of its strata, which they find of such thickness as would indicate the lapse of millions of years in its accumulation; and that, moreover, through the successive layers of these strata, are found the remains of plants and animals, in such positions as would shew that successive kinds of them had lived and become extinct during the long intervals between the deposition of the first and last orders of strata.

In the following treatise, then, we propose,

I. To take a view of those facts and appearances which are supposed to indicate a great antiquity of the earth.

II. To compare those facts and appearances with the Mosaical account of creation, the only historical record which has reached us of the age of the world. And,

III. To give a brief sketch of geological theories, and the progress of opinion on the subject, to the present times.

It has been computed, that the aggregate thickness of the sedimentary stratified rocks, as far as they have been investigated in Europe, may amount to about thirty thousand feet, beginning at the primary schistose strata, and ascending in the order of their supposed successive depositions to the chalk and tertiary beds.

The following table exhibits a view of those formations, one or more of which are generally superimposed on each other, with an estimate of their medium aggregate thickness.

PRIMARY FORMATION.

		feet.	feet.
Gneiss, Mica slate, Clay slate, &c.	Thickness uncertain, but in some situations calculated at 10,000 to 20,000		15,000
Greywacke slates, Limestone, &c. Old red sandstone,	Sometimes superimposed on the primary strata, or below the carboniferous, 5000 to 10,000		7000

CARBONIFEROUS FORMATION.

Mountain limestone varies from		50 to 900	3000
Carboniferous sandstone varies from		1000 to 5000	

SALIFEROUS STRATA.

Magnesian limestone,		300	1200
New red sandstone,		900	

OOLITIC FORMATION.

Lias,		500	1700
Oolite,		1200	

CHALK FORMATION.

Greensand,		500	1100
Chalk,		600	

TERTIARY FORMATION.

Sand and clay, Plastic clay, crag, &c.		900	900

From this table, it appears that the aggregate thickness of those formations most usually superimposed on each other is,

In the older series about 26,000 feet.

In the newer series about 5000 feet.

The whole of these strata are not, however, found overlying each other. In England, where

the most accurate sections have been made, and where the most regular succession of these strata takes place, the primary rocks are found associated on the north-western side of the island, the coal measures and new red sandstone in the middle, while the lias, oolite, chalk, and newer formations, form the eastern and southern boundaries.* It is also sufficiently ascertained that the aggregate thickness above mentioned does not extend throughout the whole space occupied by those strata. Indeed, it may be assumed as the maximum rather than the average thickness, for many of the strata are very unequal, deepening in some places so as to form hollow troughs, and thinning out in others so as entirely to disappear. Yet, taking the most moderate computation, the mass of accumulated matter appears so enormous, that, in the opinion of many geologists, its gradual deposition, in layer after layer, must have occupied a vast period of time, which has been so far divided into epochs or eras from indications of change and revolution which the strata seem to have undergone.

Now, it must be observed, that in many of the sedimentary formations, but especially in the primary strata, it is exceedingly difficult to ascertain their actual thickness. A succession of stratified rocks may, on a general view, appear to

* See Section, Plate IV.

have a continuous inclination to each other for miles in extent, and thus seem of enormous thickness, whereas it may only be a bed of very moderate dimensions, broken up by repeated wave-like eruptions of igneous rocks from below, which may not always make their appearance on the surface. The sedimentary matter may have originally been deposited by a current of water flowing over a sloping channel, by which means a succession of inclined strata may have been formed, extending for a long space horizontally, although of no very considerable depth, — a mode of deposition which may be witnessed daily in many river currents, and which has been so well illustrated by M. de la Beche.*

In the schistose strata, too, it is exceedingly difficult to form a probable guess at their thickness, from the extreme confusion and irregularity of their position, and from the lines of cleavage being often mistaken for those of stratification. If these slatey masses, too, owe their laminar, and perhaps their stratified, appearance, in a considerable degree, to a process of crystallization,† this will add to the difficulty of ascertaining the actual depth of the original deposition.

* Theoretical Geology.

† *Vide* Bonse on Primary Strata.

SECTION II.

PROOFS OF THE RAPID ACCUMULATION OF SEDIMENTARY MATTER AT PRESENT FORMING.

As it is universally agreed, that almost all the sedimentary strata have been formed from the wearing down of older rocks, in a manner similar to the processes of disintegration, which are taking place in the present land and ocean, we must first examine the amount of this, in order to compare it with the operations of preceding ages.

All our rivers are continually carrying down to the sea the matter of the rocks and soil over which their currents flow. This process is daily taking place, but in seasons of flood it is prodigiously augmented; so that, the mouths of our smallest streams, basins, and harbours, are year after year filled up with the accumulated silt; and in the larger rivers of the world, extensive deltas of solid matter are heaped up for hundreds of miles into the sea.

Pliny long ago remarked the extraordinary accumulation of detritus in the Mediterranean Sea and

Persian Gulf, and the rapid advance of the land upon the sea. From more recent observations, it has been calculated that not less than one thousand square miles of solid land have been accumulated there within the last two thousand years. Celsius has also given details of the filling up of the Gulf of Bothnia, from which it appears that in many parts of this gulf, the process of accumulation had shallowed the water three feet in the course of fifty years. According to Linnæus, the annual increase of land on the eastern side of Gothland, near Hoburgh, had been for ninety years at the rate of from twelve to eighteen feet in extent.

Sir George Staunton estimated the waters of the Yellow River in China to contain one part of earthy matter in two hundred; and that the river carried down hourly two millions of cubic feet, or forty-eight millions daily. From some recent experiments on the waters of the Ganges, Mr Everest has ascertained that, during the rainy season, the river holds suspended upwards of one four-hundredth part by weight of earthy matter, and he has calculated that, taking the average of the whole year, the enormous quantity of six thousand three hundred million cubic feet are discharged annually, —a mass equal in bulk and weight to sixty of the great Pyramids of Egypt. The delta forming at the mouth of this river, extends to a length of two hundred and twenty miles.

Major Colebrook mentions the rapid filling up of some of the branches of the Ganges, and the excavation of new channels, where the mass of soil removed in the course of a few years amounted to forty square miles, or 25,600 acres. The immense transportation of earthy matter by the Ganges and Megna, is proved by the great magnitude of the islands formed in their channels, during a period far short of a man's life.*

Similar accumulations are in the process of formation at the mouths of all the great rivers of the world. The Amazon carries the disintegrated rocks and soil of the South American continent into the Atlantic Ocean. Captain Sabine could distinguish the current of this immense river three hundred miles out at sea; and, aided by an oceanic current flowing with the rapidity of four miles an hour, from south to north, the sedimentary mass is carried on as far as the mouth of the Orinoco, forming an extensive swamp along the coast of Guiana, and a long range of muddy shoals bordering the marshes. The sediment of the Orinoco is partly detained, and settles near its mouth, causing the shores of Trinidad to extend rapidly, and is partly swept into the Caribbean Sea by the equatorial current. The rivers which flow from the high lands of Mexico, especially when swollen by the tropical

* Lyell's Geology. Cuvier's Ossmens Fossiles. Playfair's Illustrations of Hutton.

rains, carry down an enormous quantity of rocky debris and mud to the sea. But the oceanic current flowing rapidly across their mouths, prevents the formation of deltas, and preserves an almost uniform line of curve on that coast.

The Mississippi, with its numerous tributary rivers, sweeps through many thousand miles of the North American continent. The alluvial plain of this great river is bounded on the east and west by great ranges of mountains, stretching along their respective oceans. Below the junction of the Ohio, the plain is from thirty to fifty miles broad; and after that point, it goes on increasing in width till the expanse is perhaps three times as great. The river traverses the plain in a meandering course, describing immense and uniform curves. After sweeping round the half of a circle, it is carried in a rapid current across its own channel, to another curve of the same—uniformity upon the opposite shore. The river is continually wearing down these curves, and when the bendings approach near to each other, high floods frequently burst the intervening portion of land. At one spot, called the "grand cut off," vessels now pass from one point to another, in half a mile, to a distance which it formerly required a voyage of twenty miles to reach. After the flood season, when the river subsides within its channel, it acts with destructive force on the alluvial banks, rendered soft by the recent inun-

dation. "Some years ago," says Captain Hall, "when the Mississippi was regularly surveyed, all its islands were numbered from the confluence of the Missouri to the sea; but every season makes such revolutions, not only in the number, but in the magnitude and situation of these islands, that this enumeration is now almost obsolete. Sometimes large islands are entirely melted away, at other places they have attached themselves to the main shore, or, which is the more correct statement, the interval has been filled up by myriads of logs, cemented together by mud and rubbish. During floods, when the Mississippi and its tributaries overflow their banks, the waters being no longer borne down by the main current, and becoming impeded among the trees and bushes, deposit the sediment of mud and sand, with which they are abundantly charged. Islands arrest the progress of floating trees, and they become in this manner reunited to the land, the rafts of trees, together with mud, constituting at length a solid mass. The coarser portion subsides first, and the most copious deposition is found near the banks where the soil is most sandy. Finer particles are found at the farthest distances from the river, where an impalpable mixture is deposited, forming a stiff unctuous black soil. Thus, the river, by the continual shifting of its course, sweeps away during a great portion of the year considerable tracts of alluvium, which were

gradually accumulated by the overflow of former years.* Immense accumulations of trees and other vegetables are also taking place on these rivers—thus affording facts for the illustration of the origin of coal beds. Captain Hall thus describes the raft of the Atchafalaya. "This river flows out of the Mississippi, at a point about two hundred and fifty miles from the sea. Twenty seven miles from the efflux, a raft begins, and extends over a space of twenty miles; but as the whole distance is not filled up with timber, the aggregate raft is only about ten miles long. The width of the river is two hundred and twenty yards. The raft extends from bank to bank, and is supposed to be about eight feet thick. It has been accumulating for upwards of fifty years, and is annually increased."† According to Darby, a section of the banks of this river, at low water, exhibits, first, an upper stratum, consisting of bluish clay, common to the banks of the Mississippi; below this, a stratum of red ochreous earth, peculiar to Red River, under which the blue clay of the Mississippi again appears. And this arrangement, he says, is constant, proving that the waters of the Mississippi and the Red River occupied alternately, at some former periods, considerable tracts below their present point of union.

* Flint's Geography of America. Lyell, vol. i.

† Travels in America.

But the waters of the ocean having an infinitely more extended surface to act upon, are also accumulating detritus to an enormous extent. Not only do the tidal waves incessantly wear down and encroach upon the shores, but oceanic currents flowing over half the circumference of the globe, with considerable impetuosity, abrade the rocky depths and channels, and heap up and accumulate masses which, in many situations, are of very great magnitude. "So great," says Mr Lyell, "is the quantity of matter held in suspension by the tidal current on our shores, that the waters are in some places artificially introduced into certain lands below the level of the sea; and by repeating this operation for two or three years, considerable tracts have been raised in the estuary of the Humber, to the height of about six feet. Large quantities of coarse sand and pebbles are also drifted along at the bottom, and where such a current meets with any deep depression in the bed of the ocean, it must necessarily fill it up, just as a river when it meets with a lake in its course, fills it gradually with sediment." The bed of the German Ocean, according to the accurate survey of Mr Stevenson,* is traversed by several enormous banks, one of which, occupying a central position, extends from the Firth of Forth in a north-easterly direction, to a distance of one

* Edin. Phil. Journal, vol. v.

hundred and ten miles. Others run from Denmark and Jutland, upwards of one hundred and five miles to the north-west; while the greatest of all, the Dogger Bank, stretches for upwards of three hundred and fifty-four miles from north to south. The whole superfices of these shoals is equal to about one-fifth of the entire area of the German Ocean, or to about one-third of the whole extent of England and Scotland. The average height of the banks measures about seventy-eight feet; the upper portion consisting of fine and coarse silicious sand, mixed with shells and corals.

If such, then, be the ascertained rate at which detrital matter is constantly accumulating by the action of rivers and the ocean, it ought to afford some data for ascertaining the period within which the ancient and now consolidated strata of the globe were formed. Thus, suppose that our largest rivers accumulated one foot in depth of solid strata annually, we would have, in two thousand years, a deposit of the same amount over the space which their waters covered. And suppose that the ocean, on an average, accumulated one-fifth of this quantity over its whole superfices annually, and that this matter was collected by tides and currents into numerous beds of unequal thickness, we can easily conceive, that over particular regions, the accumulated collection of oceanic and fluviatile debris would amount, in the same period of time, to masses of

strata of enormous thickness, filling up large hollows and troughs in the bottom of the sea. Suppose that in some of these situations, an accumulation of five to ten feet occurred annually, we should thus have, in two thousand years, a mass of strata, varying from ten to twenty thousand feet in thickness, thus equalling the depth of the thickest ancient accumulations yet discovered. "In certain parts of the globe," says Mr Lyell, "continuous formations are now accumulated over immense spaces along the bottom of the ocean. The materials undoubtedly must vary in different regions, yet for thousands of miles they may often retain some common characters, and be simultaneously in progress throughout a space, stretching thirty degrees of latitude from south-east to north-west, from the mouths of the Amazon, for example, to those of the Mississippi, as far as from the Straits of Gibraltar to Iceland. At the same time, great coral reefs are growing around the West Indian islands, and in some parts streams of lava are occasionally flowing into the sea, which become covered again in the intervals of eruptions with other beds of corals. The various rocks, therefore, stratified and unstratified, now forming in this part of the globe, may occupy, perhaps, far greater areas than any group of our ancient secondary series which has yet been traced through Europe."

* Principles of Geology, vol. ii.

Considering these circumstances, then, is it not reasonable to suppose, that, if the present ocean bed were elevated by subterranean forces above the level of its waters, and converted into dry land, we should find strata of the depth and magnitude which the present causes in action would lead us to calculate on.

Now, although it is presumed that the same causes which now operate were in action during the production of the more ancient strata, yet certain modifications may have formerly tended to aid the more rapid increase of detritus over the surface of the globe. In the first place, the primitive condition of the surface may have rendered it more liable to disintegration by aqueous action. The first igneous rocks, formed probably under less pressure, may have been of a softer and more porous nature than the later granites, which have been produced under the pressure, not only of the ocean, but of the superincumbent strata. Neither had they any covering of debris to defend their surfaces from the abrading torrents; for the greater the accumulation of detrital matter, the greater must be the protection to the subjacent rocks.

Then, there are several indications which would lead us to suppose, that, at the period of the deposition of the earlier strata, the average temperature of the globe was considerably higher than at present; that is, that a temperature approaching to tropical prevailed over the temperate and even frigid zones.

May not this have influenced greatly the rate of evaporation, and consequently increased the quantity of rain, and the number and magnitude of rivers; while, at the same time, it would greatly augment vegetation, and amply supply the mass of vegetable remains which contribute so largely to swell the bulk of the carboniferous strata? We allow that these are so far hypothetical arguments, though the last statement is warranted by facts which are obvious to every geologist. The coal beds abound with numerous vegetable remains of ferns, reeds, and other cryptogamic plants, which have evidently flourished in great numbers in low marshy plains, besides trees of an immense size and of a higher class of vegetation, which must have been borne down by the impetuosity of currents from more elevated grounds in the ancient continents.

SECTION III.

DIFFERENT FORMATIONS MAY BE CONTEMPORARY.

THE next circumstance to be considered is, whether all the sedimentary strata have been deposited one after the other from the primary starta onwards to the most recent tertiary beds, in a regular sequence of time, or whether several of the groups have not had a contemporaneous formation. There can be no doubt, but that some of the formations have been regularly deposited, one after the other, which is proved by their positions, line of stratification, and from some of the newer strata, containing fragments of the older; but, then, it cannot be so easily demonstrated that this has been the case with the whole. It cannot be proved, for instance, that the great carboniferus groups may not have been partly deposited during the period when the lias and oolite were in the process of formation; or that a contemporary deposition has not taken place among some of the other members of the newer formations.

As to position in England, and the corresponding portion of the continent of Europe, the boundaries of these respective strata can be traced by well defined lines of separation.

The great coal fields of Britain lie in hollow troughs or valleys, formed by the previous disturbance of the mountain limestone and older sedimentary strata on which they rest. These coal beds have most probably been accumulated by the action of rivers carrying down vegetable and earthy matter into the basins of estuaries. The lias and oolite again seem more strictly the production of littoral oceanic currents sweeping along the shallow shores. Yet, with some trifling exceptions, the latter formations are not superimposed upon those of the coal measures, but lie in distinct beds. We do not at present take into consideration the characteristic fossils of each, because this subject will be treated of afterwards.

We think it admits of demonstration, too, that the last great change on the British strata, by which they were finally elevated above the ocean, took place at one period, or, at least, at periods nearly contemporaneous.

Thus, if the northern coal fields of England and those of Scotland were elevated above the level of the sea, at a period long antecedent to the existence of the lias and oolite beds of the south-east of England, where are the traces on the surface of the

operations which must have taken place in the long period necessary for the production of the latter? We have no formation older than the carboniferous sandstone, from Newcastle to the Grampian mountains of Scotland, with the exception of a few local patches of new red sandstone. The strata of the coal measures are seen tilted up to the surface; a few feet of diluvial gravel and clay are superimposed, but from the period when the matter forming the carboniferous series ceased to be deposited, till the commencement of the system of vegetation which at present exists on the surface, there are no geological records to mark the lapse of any considerable period of time.* That the superimposed diluvial matter was deposited at the period of the elevation of the sandstone rocks, and could not be of a more recent era, is also demonstrable from its containing the same coprolites as the shale of the inferior strata. These clay ironstone nodules are found among this diluvium in all parts of the country, and lying immediately above the tilted up strata of the carboniferous limestone, as well as the various beds of the coal measures; and though they are in composition exactly the same, and contain the same coprolites and portions of fishes and plants, yet many of them have a less compact structure, and are of a lighter ochrey appearance, than

* See Section and Note I.

those found in the shale,—a proof that they are not part of those latter broken up, and scattered by a more recent denudatory process, but originally from one common source, part having been enveloped in the shale and part in the diluvial detritus. It may be asserted, that denudation may have swept away any newer formations; but the sharp and unworn edges of the sandstone, the total absence of all traces of a newer formation, while the cracks and fissures of the strata are universally filled with the matter of the superimposed diluvium, in which are mingled portions of the trap rocks, which were the elevating agents — indicate the total improbability of the existence of any such newer strata. To the north of the Grampians, again, where the coal series is wanting, we find small patches of the lias formation, accompanied by the new red sandstone, both lying immediately above the old red sandstone conglomerate. Now, as regards the older or primary strata, the south and north sides of the Grampians exhibit an exact similarity, the same central granitic ridge having elevated both at the same period; but on the south of the Tay and Frith of Forth, the carboniferous limestone and sandstone have been largely deposited, while on the north no such deposit has taken place; but instead of it is found a non-carboniferous sandstone in extensive beds, above which are traces of the lias limestone, with its peculiar fossils. Now, the question is, when was this

lias deposited, if not during some part of the era of the coal deposition?

If, then, the northern part of England became dry land at the same period as the south-western, the deposition of part at least of the carboniferous strata must have been contemporary with that of the lias and oolite.

If, on the other hand, the reverse be maintained, that while the south of England was dry land, the northern portions of the island were covered by the ocean, the same arguments apply. For either the deposition of the coal strata was going on contemporaneously with the formation of the oolitic beds, or some equivalent system of operations must have been apparent above the coal measures.

SECTION IV.

SOME FORMATIONS HAVE BEEN SUDDENLY DEPOSITED.

THERE are facts which indicate, that in many situations the deposition of the sedimentary strata was not a gradual and uniform process, the result of successive years or of ages, but that masses of some hundreds of feet in depth were accumulated in a very short space of time, by causes similar to sudden floods or inundations of rivers. Thus, in the coal strata, trees of from thirty to forty feet in length are found lying very slightly inclined from the vertical position, and crossing numerous beds or layers of strata, among which they are enveloped. This is well displayed in Craigleith Quarry, near Edinburgh, which consists of a mass of sandstone and shale, the depth of which, so far as at present explored, is about two hundred feet. This sandstone, in many places, bears evident marks of having been drifted by some impetuous current of water; and, besides the trunks of trees already mentioned,

contains, especially in its superficial layers, immense quantities of the stems of equisetæ, stigmariæ, and other buoyant plants, which appear from their lightness to have floated on the sedimentary mass, and to have thus been deposited near the top; while the heavier trunks of solid wood, after having been saturated with water, and rendered specifically heavier than the surrounding mass, have sunk and become entangled in the consolidating materials. It is impossible to conceive that these trees could have been preserved as they are, with their internal structure so accurately portrayed, had the upper portions been exposed for even a few months to the action of the air. The same remark applies to the trees found in the Newcastle coal fields, and other situations, with their roots, and apparently portions of soil attached to them: these must have been suddenly overturned in the spot where they grew, or, what is more probable, they have been uprooted and drifted by the current; but, in either case, rapidly covered over with the enveloping sand and mud. If we thus, then, have proofs of strata, two hundred feet in depth, having been formed suddenly, may we not apply the same analogy to other strata, where proofs of the fact are not now so evident?*

But besides mechanical disintegration and accumulation, there are also circumstances in the

* Note II.

appearance of some of the formations which would indicate a chemical deposition, which may have taken place in a comparatively short time, and to a considerable extent of thickness, under the combined actions of heat and aqueous mixture. This is particularly remarkable in the chalk; the extreme uniform minuteness of its particles, the unmixed purity of its composition, its loose and slightly coherent texture, and its cavities filled up with concretions of siliceous matter,—all pointing out a chemical more than a mechanical deposition.

Perhaps the same conjecture may be applied to the magnesian limestone, and extended, with some degree of probability, to portions, at least, of the oolitic strata.

That the gypsum and salt beds of the new red sandstone indicate chemical action, is also apparent, while the position of the accompanying strata of sandstone and conglomerate, shew considerable transportation and accumulation of their materials.

Finally, the sedimentary strata, even in their greatest thickness, constitute but a very small proportion of that part of the globe elevated above the level of the ocean. The igneous rocks formed in the bowels of the earth, and thrust upwards by volcanic convulsions, make up by far the greatest part of the mass of our continents and islands. These rocks are only visible as they constitute mountain chains, and occasionally as they break

through the superincumbent strata ; but their existence is no less demonstrable in our level plains and undulating valleys. In fact, the lowest and most horizontal strata must have been raised to their present position above the level of the sea by the agency of such igneous masses. It is not necessary that we should here inquire into the causes of these elevations ; * but it is now admitted on all hands that operations, corresponding, in an intimate degree, with modern volcanic actions, were at work in their production. The extent of these ancient mountain chains, the manner in which they appear to have elevated the strata of whole islands and large portions of continents, by one continuous and uninterrupted process, seem, however, to indicate, that though the causes were similar to volcanic, yet that the amount of the forces and the extent of the operations were in an infinitely greater degree, and much more general, than any witnessed in modern times.

That repeated elevations of this nature have occurred at very distant intervals, is quite evident from the appearances of the disrupted strata ; and from indications in this strata, certain relative periods of convulsion can be distinctly pointed out. Thus, an early eruption has evidently elevated the primary or oldest gneiss and mica slate

* Note III.

systems. Another eruption has occurred at the period of the greywacke deposition, and a third posterior to the formation of the coal strata; and these operations are continued, and brought down even to the present period of volcanic action.

But the very aspect of the various kinds of igneous rocks shews that they were formed under different circumstances. Thus granite differs from the porphyries and greenstones; and these again, in some degree, from the more recent lavas, shewing that a varying degree of superincumbent pressure, or of intensity of force, or magnitude of the masses in action, may have thus taken place at the successive periods of their production. Because the elevating power of modern volcanoes, then, is a slow and gradual process, to maintain that the more ancient eruptions must also have occupied a lengthened period, is a conclusion which, taking all the circumstances into consideration, cannot be admitted.

SECTION V.

SUCCESSIVE SERIES OF ORGANIC REMAINS IN THE DIFFERENT FORMATIONS.

THE next argument in support of the great antiquity of the earth, is the successive series of animal and vegetable remains peculiar to each of the fossiliferous strata. For it is supposed, that not only in each of the leading formations, but in many cases in each subordinate bed of such formations, peculiar kinds of organized beings have flourished for an epoch, and then disappeared, to be succeeded by a fresh creation of animal and vegetable existences. Now, it cannot be denied that such a gradation of fossil remains does exist, though extended discovery is daily making innovations on the various theories of their classification, and the deductions too hastily drawn from isolated facts. Yet we shall assume, that, generally speaking, each formation is characterized by peculiar fossils.

In considering this subject, we must leave out of view the original creation of organized

beings, as a matter utterly beyond our comprehension, and consequently without the field of our reasoning. But, looking on nature as it exists, we see no power or tendency in her works to produce organized existences from inorganic matter, neither have we any facts to shew that new species can be propagated and continued from existing organic life. On the contrary, a definite law of nature confines the production of new beings to a parent of the same species. It cannot be urged that time is necessary for the development of this phenomenon: did the law or tendency exist, it would most assuredly operate continually. Seeing, then, that there are no facts or analogies in nature to support the idea of a successive creation of species, it is unphilosophical to extend such an assumption to the past period of the earth's history.* That many species of plants and animals which once existed may have become extinct, however, is a circumstance which readily admits of illustration. Thus, partial extirpations of animals are taking place in every country as the numbers of mankind increase, and changes are brought about on the surface of the soil. The wolf, the beaver, and some kinds of deer, have entirely disappeared from Britain within the last few centuries; and the dodo is a well known example of a bird extirpated from

* Note IV.

the earth within the records of history. No doubt, many animals have thus been removed from their localities by the various changes which have taken place on the surface of the globe, and may have been either partially or totally extirpated in the revolutions which have changed the ocean into land, and levelled continents into the ocean.

Of the whole number of fossil animals yet discovered, amounting to about six thousand six hundred, the greater proportion are marine—consisting of coral zoophytes, molluscous animals, and fishes. From the sedimentary strata hitherto examined being almost exclusively marine and fluviatile, this was a circumstance which might readily have been anticipated. In the primary or lowermost series of sedimentary rocks, no organic traces can be found. It is only in the greywacke and older sandstones that they begin to make their appearance; and they do so at a distinct and definite point, evidently shewing a period of commencement of organized existence on the earth.*

* "In the greywacke of the Cambrian mountains, there occur organic remains in the upper and middle portions, but none in the lower, though similar in all other respects. The same is the case in North and South Wales. I may state generally, as the result of my own observations on the older strata of this island, that there is a line in the descending series where organic remains seem entirely to disappear, and that this is by no means co-ordinate with mineral changes, nor produced by igneous action."—Professor Sedgewick, in *Geological Transactions*.

In the first fossiliferous strata, the animal remains are of rare occurrence, and confined to a few species, consisting of crustaceous animals and fish, supposed to be the inhabitants of deep seas. In the succeeding strata, or mountain limestone, these animals disappear and are succeeded by encrinital polypi, coral zoophytes, and shell mollusca. The coal measures deposited in the hollows of the elevated limestone contain few animals, and those chiefly fluviatile, but abound in plants and large trees. Then we have the new red sandstone partially lying over the coal measures, containing very few traces of organized beings, but come again to the lias and oolitic beds, which are full of shells and animals, that have had their localities in shallow seas near the shores of continents. Over these is superimposed the chalk, a marine deposit, also containing marine shells and crustacea, and a series of tertiary strata, both fresh water and marine, terminates the whole.

Now, although each of these formations, generally speaking, contains a certain amount of distinctive species, yet there are some tribes of animals which range throughout the whole. Thus, various species of coral zoophytes are found in all the strata; terebratulæ, also, are common through the whole; ammonites extend throughout all the strata, except the tertiary; spirifers and productæ extend through all the series to the oolite; while belemnites only

appear in the lias, oolite, and chalk; and the echinæ in the chalk alone. In short, these fossil animals appear to have strictly conformed in their habits to recent species. They had certain localities which they frequented as being suited to their organization; some inhabited deep seas; some littoral situations, and others the shallow estuaries of rivers. And, when certain changes of the sea, affecting its depth, temperature, and other circumstances, occurred, the races either changed their localities, or became extirpated. Thus, when the deep and ancient bed of the greywacke system was elevated and formed a shallower sea, the inhabitants of the locality found it no longer a fit abode for them; but this revolution prepared a suitable bed for the encrinites and mollusks of the succeeding limestone deposit. This bed, too, after a certain period, suffered an elevation, and became a shallow estuary for the reception of drifted vegetables. In an adjoining bed of the ocean, certain currents were accumulating the debris of a neighbouring region, charged with numerous shell animals, and rivers flowed into these beds, where saurian reptiles formed appropriate habitats. But the question will be asked, were the species of the respective beds co-existent? The proposition has more of analogy to support it than the alternative of separate and distinct creations. If we find a low and marshy plain, where only reeds and mosses have hitherto grown, by some means

gradually filled up with dry rich soil, and this soil, in the course of a few years, covered with a variety of luxuriant vegetation, we do not hastily conclude that a new creation of vegetables suited to the particular soil has been effected, but reflect that seeds from other similar situations may have been transferred, and finding a suitable soil have here taken root and flourished.

Those portions of strata hitherto examined may have thus been successively stocked, from some common centre, with animals suited to the nature of the localities. Those animals may have been, as it were, the pioneers of Nature, and after having performed their allotted duties, may have suffered extinction in the successive changes which the respective strata that they occupied have evidently undergone; while other races, forming the great majority, in more favoured localities, may have remained to extend over the seas and oceans of the existing period.

It does not by any means follow, that because we find successions of different animals occupying beds superimposed upon each other, that the extinction and new creation of species have been the cause. In the successive beds of some strata we find the same species repeatedly alternating with other distinct species, and in some instances recurring in such numbers as to form the almost exclusive relics of the higher beds. Now, we cannot surely

here have recourse to repeated creations of the same species.*

That species belonging to the four great divisions of the animal kingdom existed at various periods of the secondary formations, is now put beyond all doubt. Dr Hitchcock has discovered what he conjectures the remains of mammiferous animals, in the greywacke of America.† The footmarks of reptiles and birds have been evidently traced in slabs of new red sandstone; the bones of a didelphis in the oolite or Stonesfield slate, near Oxford; and bones of birds in the Wealden beds of Sussex, below the chalk.

Considering that all these formations are of aqueous deposition, the few remains of land animals which they exhibit are sufficient proof that terrestrial beings existed as contemporaries of the marine on some part of the surrounding soil.

That the marine animals of the earlier formations differ so much from those of the oolite and chalk, which are both strictly of marine origin, may arise not so much from a difference of age in those strata, as

* Mr Mammalt, in his elaborate work on the coal field of Ashby de la Zouche, full of the idea that "strata are characterized by their fossils," maintains, that every shale bed of this coal field has vegetable impressions peculiar to itself. An examination of his plates, however, which are truer to nature than his theory, shews the same species of fossils repeated many times in different beds.—GREENOUGH'S *Address to Geological Society*, 1835.

† Silliman's American Journal, 1837.

from the nature of the localities and circumstances under which the different beds were formed. But if we take two fluviatile beds—two localities where, from all appearance, rivers have discharged their contents into the ocean—we should here expect a more general coincidence, both of animal and vegetable remains.

Accordingly, if we take the remains found in some of the carboniferous strata in the neighbourhood of Edinburgh, and compare them with those of the Wealden beds in Sussex, we shall find a very close resemblance in the genera, if not in the species. Thus, the cryptogamic plants of both are sphenopteres and equisetæ; numerous entomostracæ, or fresh water crustaceous animals of similar genera, are common to both; species of the genus unio are also found in each, and perhaps farther investigation will shew a closer resemblance between the bones of the larger animals than has hitherto been imagined.* Now, the Burdiehouse limestone and superimposed coal beds are placed by geologists next to the very oldest fossiliferous strata, while the Wealden beds lie above the oolite, and immediately below the chalk. According to the usual computation, many millions of years must have elapsed between the two formations, and yet every fact shews that a similar climate, and other local con-

* Note V.

comitant circumstances, were favourable to the existence of similar plants and animals in each.

It is maintained, too, that an inconceivable lapse of time must have been necessary for the maturation and successive decay of the immense numbers of certain species of mollusks, which are found composing strata of considerable thickness. Yet, if we reflect that many molluscous animals in the present time multiply by millions annually, and that, within a short period, coral reefs of thousands of miles are constructed by minute zoophytes, we need not be surprised that, under favourable circumstances, a few centuries should have produced its myriads of fossil beings.

That many of those fossil animals lived and died in the beds where we now find them is exceedingly probable, but we must also bear in mind that a considerable number must have been collected by means of tidal and fluviatile currents already described.

Another argument in favour of repeated creations, and of preadamite worlds, is, that the great proportion of fossil animals and plants consist of extinct kinds—that of all the number hitherto discovered, a very few indeed are of existing species. Now, this is undoubtedly a fact not readily accounted for. But we must consider,—

1st, That the ancient marine strata, in which the greater part of these remains are found, were at one

period, in all probability, under a tropical climate, and formed, moreover, the outskirts of a region under the process of progressive organization.

2d, That organized beings suited to such circumstances first took possession of the strata.

3d, That we are still ignorant of perhaps one-third of the forms of animals and vegetables existing on the earth, and, consequently, cannot pronounce the fossil ones to be of an exclusive kind; and that as proof of this, every year is adding new living genera and species as analogues of the fossil kinds.

Lastly, That peculiarities of climate, modifications of the saline portions of the ocean, and other local changes, may have so far influenced the external forms of many testaceous mollusca, as to deceive the most practised conchologist with regard to the species; and that, indeed, in many instances, it is impossible from the fossil shell positively to decide on the species of many genera.

It may be observed, too, that the gradual passing of the extinct species into the existing, which appears to take place in some of the tertiary beds, may be in consequence of the localities of those beds gradually approaching the original centres where organic beings were first produced.

Another important circumstance has to be noticed, that as yet only about seven thousand fossil animals and plants have been discovered. It can never be

supposed that this number sufficed for the ancient system of things, and filled a world which now contains thirty times the number—nay, probably three times this proportion.*

A mere fraction, then, of the organic remains of former strata, has yet become familiar to us, and it would be absurd to form any sweeping conclusions under our present ignorance. Certain animal bodies may be more calculated for preservation than others, as has been proved to be the case with plants. From some experiments of Professor Lindley, it is shewn that, while recent dicotyledonous woods and herbaceous plants are reduced to an impalpable mass by two years maceration in water, the ferns and other members of the cryptogamic class, together with the pines, retain their organic structure unimpaired, — thus shewing that we are indebted to the few species of the numerous plants that must have entered into

* Comparative list of living and extinct species of plants and animals,—

	Existing.	Extinct.
Plants,	60,000	600
Zoophytes,	1,000	770
Mollusca,	6,000	4,800
Articulata,	110,000	400
Fishes,	5,500	500
Reptiles,	2,000	60
Birds,	5,000	10
Mammalia,	1,200	60

the coal seams, to their superior power of resisting moisture; and that when dicotyledonous structures are preserved, it is in those strata called the newest, because in them they have been probably entombed in drier terrestrial soil, more congenial to their preservation.*

The skeletons of terrestrial quadrupeds and other mammalia, are found almost universally diffused over the surface of the globe, imbedded in the diluvial clay or gravel, and insinuated into caves and fissures of rocks. These animals consist of extinct species and genera mingled with several species at present in existence.† The remains of the mammoth, hyena, rhinoceros, and other animals of a warm climate, strew the plains of the temperate and frigid regions, as well as those of the torrid zone; while, those of the hippopotamus, an animal at present confined to the rivers of Africa, are found in Europe and India;‡ and marsupial animals, now only found in New Holland and South America, are recognized among the fossils of Europe. This diluvial matter, more or less charged with relics of terrestrial animals, is found in every region strewed

* Lindley and Hutton, Fossil Flora, vo . iv.

† Note V.

‡ Mr Marsden describes the hippopotamus as being at present an inhabitant of Sumatra. This is a singular circumstance of a terrestrial animal of this size being found in an island contiguous to a continent, and not in that continent itself.

over the uppermost strata, of whatever series that strata may be. It is the opinion of many, that this diluvium may be of very different ages, but it is somewhat singular that it is never found with newer strata superimposed on it, which it could scarcely fail to have been, had it outlasted the numerous convulsions and revolutions assigned to the different periods of the earth's formation. A few exceptions present themselves, where skeletons of mammalia have been found below, and alternating with, marine and fluviatile shells, as in the Paris Basin, so minutely described by Cuvier. That these beds, however, were transported into their present position, under circumstances where an oceanic current commingled with a fluviatile, is a more likely supposition than the idea of their repeated submergence and elevation, and their successive occupation, at distant intervals, by marine and terrestrial animals.* As a confirmation of this, more recent discoveries in the diluvium of the lower range of the Himmala Mountains have shewn that the paleotherium, a quadruped hitherto ranked in the lowest era of the tertiary beds, has actually been a contemporary with the camel, the cat, the monkey, and other existing beings.† May we not expect that farther discovery in this interesting

* See Prevost's Remarks on Cuvier.

† Asiatic Journal, 1837.

department will more fully bring to light many circumstances calculated to elucidate these points?

So little do we yet know of fossil remains that it is only within the last twelve months that bones of the monkey tribe have been discovered of undoubtedly an ancient fossil character. That no well authenticated relics of man of a very ancient date have yet been discovered, may be accounted for in several ways.

1st, Because the countries hitherto minutely examined by geologists most likely were not inhabited by man at a remote period.

2d, Because the numbers of mankind in the earlier stages of the world must have borne such a small proportion to that of the other terrestrial animals, that the chance of finding a stray human relic among the drifted marine strata would be very small indeed.

3d, Because it is not improbable, as Cuvier supposes, but that the portion of dry land which formed the habitation of the early races of men has been now totally submerged in the ocean. "Every circumstance," says this naturalist, "tends to establish this position, that the human race did not exist in the countries in which the fossil bones of animals have been discovered at the epoch when these bones were covered up, as there cannot be a single reason assigned why men should have entirely escaped from such general catastrophes; or if they also had been

destroyed and covered over at the same time, why their remains should not be now found along with those of the other animals. I do not presume, however, to conclude that man did not exist at all before these epochs. He may have then inhabited some narrow regions, whence he went forth to repeople the earth after the cessations of those terrible revolutions. Perhaps, even the places which he then inhabited may have been sunk into the abyss, and the bones of that destroyed human race may yet remain buried under the bottom of some actual seas—all, except a few individuals destined to continue the species."* And,

Lastly, Because theories render geologists now averse to believe the possibility of finding a true fossil man—*a homo diluvii testis.*†

It is no wonder that those individuals who, with such consummate perseverance and discrimination, first unravelled the mysteries of fossil remains, felt their minds excited as they viewed before them the restored forms of the beings of an infant world, and that they should be disposed to entertain somewhat exaggerated views of their relations to existing species. That mind, which, from the contemplation

* Cuvier's Ossmens Fossiles, tom. i.

† Notices of those ancient human skeletons, hitherto found in caves and rocks, will be found in Greenough's Geology, Lyell's Elements of Geology and Philosophical Magazine for 1836-7.

of a few broken fragments of bones, was able to build up an induction of facts illustrative of the whole form and habits of the animal to which they belonged, might well be pardoned if it tended to magnify the importance of the study. The very novelty of the forms of these lost beings, their unaccountable fate, and the interest of antiquity with which they are invested, render them infinitely more singular to us than the oldest Cheops from a Theban tomb. But is there any thing in their size, structure, or presumed habits, which would seem to have unfitted them for the present system of things? Or, after years of sober consideration, are they still found so strange and anomalous that it should be deemed necessary to construct a pre-adamite world for their reception?

The mastodon does not exceed in size our largest living elephants. The megatherium, prodigiously massive as its skeleton is, may perhaps be rivalled by the unwieldy rhinoceros; and, indeed, animals possessed of a more ponderous frame would have been altogether unsuited for locomotion on our earth as it is now constituted. Then, again, we have existing crocodiles and caymen as large as the plesiosaurus. Our whales of seventy feet in length must be reckoned a match for the dinotherium, which most probably was also an aquatic mammal; and for the huge iguanadon, an equivalent reptile may yet perhaps be found amid our torrid swamps

or savannahs; the pterodactyles or flying quadrupeds have a counterpart in our bats and vampyres. The combinations of structure in these, and in the plesiosaurus and ichthyosaurus are certainly to us curious, becausé they are new; yet are they more anomalous than that of the existing ornythorynchus? Amid the diversities of form in nature, we cannot properly pronounce any such combinations singular, for they are as much systematic as that of the best defined type of any great group. Neither can we set any limits to the probable combinations of organization—the field for such variation is infinite—nor, with all the grouping and systematizing of naturalists, is there any expectation of filling up and completing the imaginary bounds and limits which have been imposed on the operations of nature. She, as it has been remarked, only seems to recognize one distinction in her system,—that of the individual and species. Among the extinct animals there are no such diversities from the present as to render the creation of new classes or orders necessary, they are only so far different as to constitute new genera and species of old established classes.

SECTION VI.

CHANGE OF TEMPERATURE.

ASSUMING for a moment the truth of a very prevalent opinion, that the temperature of the globe was at one time very high, and that it has gone on progressively cooling to its present rate, we may remark, that even this theory refutes the idea of a long succession of ages being necessary for the formation of the respective strata.

We shall take for example the coal measures,—a mass of alternating strata, from three to five thousand feet thick in its deepest parts, and requiring, according to the liberal allowances of some, not less than a million of years for its formation. Now, the vegetable remains at the bottom of this series are identically the same as those at the top; but had a refrigeration of a million of years taken place in the interval, the last lepidodendron and fern should have had a totally different character from the first. The same remark applies to beds of molluscous animals.

But, indeed, we can never consider the common theories of central heat as compatible with the existence of plants or animals in a considerable portion of the globe, at any period of its past or present existence. Thus, all will allow that our present tropical temperature is due to the sun's influence alone, and the average of this heat for several months is upwards of one hundred degrees of Fahrenheit. Now, to this average heat, which must have been produced ever since the sun shone upon the earth, add fifty or sixty degrees of central heat, and we have a climate that might boil plants and animals, but would never permit them to exist.* And yet we have the carboniferous coal fields of India with the same fossils, and coeval, it is said, with the same systems of Britain! The temperature of the former and present surface of the earth, different as it seems to have been, must, we suspect, be explained on other data than theories of central heat, and none seem more fitted for this purpose than the relative change of position of large portions of land and sea, as illustrated in so ingenious a manner by Mr Lyell.†

* The mean tropical heat is calculated at 81 degrees.
At Cawnpore, E. I. in April and May, 1789. the mean heat was 127 degrees,—maximum 144 degrees.
At Allahabad, E. I. the heat is often 109 degrees in the shade.
In Georgia, maximum of heat 105 degrees.
A heat of 109 degrees proved fatal to ten thousand persons in China.

† Note VI.

Allowing the probability of this latter theory, the following considerations seem accordant to facts,—

The change was sudden and abrupt. In Europe we have no traces of intermediate vegetation between the system of extinct plants and existing species. We have animals of tropical temperatures supplanted by our present races, and some of the former, as the Siberian elephant, suddenly enveloped in clay, and frozen over so as to be completely preserved.

The change was extensive, because the coincidence of the same plants, as in the carboniferous system, and the same animals, as in fossil beds and diluvium, extending over many regions of the globe, exhibiting one era of existence, all indicate a similarity of climate. This temperature, though more elevated and uniform than that of our temperate and frigid zones, may not, however, have been even equal to our present tropical. We cannot determine, in fact, how slight or how great an elevation of temperature may have been necessary for the growth of fossil plants, or the existence of fossil animals. Thus, the Siberian elephant was clothed with long hair, indicative of a temperature not extremely warm, probably analogous to many mountainous regions in Asia, where hairy elephants were seen by Bishop Heber.

SECTION VII.

OPERATIONS AT PRESENT IN PROGRESS.

It is, we believe, almost generally allowed, that the commencement of the present system of things on the earth's surface does not claim a very remote antiquity — that, according to one view of the question, it cannot have a date anterior to the period of man's creation as fixed by Moses, or, according to others, an earlier commencement than the epoch of the Noachian deluge. A third party, it is true, are more indefinite in their chronology, but still fix the period of the introduction of man on the earth, and the commencement of the existing epoch, within the compass of the last six thousand years.*

It remains to be considered, then, whether there are any indications on the earth's surface to furnish data for such conjectures, and how far these are to be depended upon.

* Note VII.

The mechanical forces continually at work in the inorganic world are daily and yearly making inroads on the solid matter of the globe, and these, again, are aided by the chemical operations called into action by the multitudes of organized existences. The combined operations of these, then, must, in a long series of ages, have left obvious traces of their effects on the earth's surface; but we must call to mind that, from the very nature of these forces, the effects must be far more extensive and conspicuous in the bed of the ocean than on dry land.

Accordingly, when we strictly investigate the operations of time on the surface of the earth, we cannot help feeling a degree of astonishment at the little change which the lapse of three or four thousand years has brought about. Except in particular localities, we neither see a great extent of waste, nor a great accumulation; we see a partial mouldering down of rocks and precipices, and a slow excavation of valleys; a gradual disappearance of headlands, and a filling up of flat shores and shallow marshes; but the great features of continents and islands still remain unchanged—the same mountains on which the sages of antiquity looked, still rear their venerable summits—the same fields and meadows stretch out their ever verdant surfaces — the same streams and mighty rivers flow continually down from their mountain sources. To counteract the destructive powers of nature, there are compensating operations

as steadily at work, so that the green turf, ever thus renewed, outlasts the structures of man, which, under the inevitable laws of nature, are continually crumbling into dust,

And monuments themselves memorials need.

The principal operations taking place on the surface of the earth are, — the abrading effects of river courses on their channels, the accumulation of deltas at the mouths of rivers, the wearing down of promontories and headlands, and the formation of vegetable soils, especially peat moss. It has been supposed that each and all of these may afford indications of the actual and relative ages of different countries, and to a certain extent, they most undoubtedly do so. Yet, in making calculations of this nature, we must bear in mind, that the amount of disintegration will be in proportion to the impetus and constancy of the forces at work, and to the degree of hardness of the materials acted upon. Thus, some shores are of very soft materials, easily yielding to the waves, while others are so hard as to resist in a great measure any very extensive destruction. The ocean, too, after having acted with considerable force and effect on some shores for a long period, at last throws up a barrier of loose debris which shuts out its waves, and completely excludes their farther operations; tides and currents, also, interfere with the regular deposition of deltas, and circumstances take place in the course

of ages which may materially modify the impetus of rivers. Thus, the constant effect of flowing streams is to lower the level line of their courses, and consequently to lessen the velocity and force of their currents. All rivers exhibit this to a greater or less extent; the gradual lowering of the height of many waterfalls is evidently caused by the abrading force of the currents on the sides of the rocks, now many feet above the commencement of their present descents.* Under these modifications, however, this subject of inquiry is an interesting one, and deserving of farther prosecution. If a collection of accurate data of this description were made, it would then be seen how far these may tend to throw light on the actual age of particular countries, or that period when the surface of the strata first became dry land, as also on the relative ages of different continents. For it is still an important desideratum to ascertain whether the great leading outlines of the continents of the earth have had a simultaneous formation, and have been afterwards partially modified and filled up by successive operations, or whether they are of very different ages, and owe their origins to causes acting at remote intervals or epochs.

Though these disintegrating forces, then, are on the whole, gradual, and some of them checked by other compensating operations, yet they are incessant, and must, in the lapse of an indefinite period,

* Note VIII.

amount to the levelling down of the present continents. Thus, the effect of rivers is, in the first place, gradually to lower their channels to a level with the ocean, into which they enter; then this ocean flows in upon the land, forming an estuary, while its tides begin to act as disintegrating forces. In the interior, from the gradual change of levels, new streams and rivers begin to cross and intersect the country; these, too, come in time to a level with the ocean, and a farther inroad of this element is caused, till, ultimately, we have an extinction of the whole dry land.

It is remarkable, however, that in no country of the globe hitherto examined has such an extreme result of disintegrating action been discovered so as to indicate the lapse of a very remote period of commencement; not even in those very old strata which are supposed to have been elevated many ages previous to the newer formations,—a result which must have been very perceptible, if an extreme disparity of age exists in the different continents. To these processes, however, we have to oppose other conservative agencies. Of this kind are the almost imperceptible elevations of portions of continents which are said to take place, and which elevations are so far indicated by many curious facts,—such as the alterations of the sea level, and the existence of recent marine shells in situations now removed from all contact with the ocean; and the more obvious

effect of volcanic actions which are daily raising portions of dry land and of the ocean bed to considerable heights above their former level. By such processes we have the formation of new islands, the partial alteration of the surface by the elevation of new mountains, the drainage of lakes, and the change of river courses.

Although, then, in the existing condition of the globe, we are not without distinct indications of a commencement; yet we cannot, by any physical processes, anticipate its final decay or ultimate destruction. A constant succession of operations, mechanical, chemical, and vital, are taking place, and producing considerable change and modification: yet all contribute to the preservation of the whole. Amid all the transmutations of matter, nothing is lost or destroyed — amid destruction and ruin, there is a rebuilding and restoration — amid death and decay, there is a continual renewal of existence.*

But although our limited optics can trace no symptoms of a final termination; yet this by no means proves that such a progression may not be taking place in nature. The inspection of a tree in the full vigour of its growth, would never inform us, without the aid of analogical experience, that

* "And herein Nature's art is wonderful, that having circumscribed itself within certain bounds, all within it which seems corrupting, waxing old or useless, it transforms into itself, and out of them makes other new forms, so as neither to need matter from

this tree had a commencement from a small germ, and that, in process of time, its trunk will gradually moulder to a mass of dust. And there is, in the full maturity of the animal frame, all the apparent requisites for an immortality of existence,—a continual waste of materials, it is true, but a most perfect system of rènovation also. Yet dire experience convinces us, that the law of dissolution is inseparable from all organized existences; nor, on looking on the full grown man for the first time, could a being of still more limited experience ever imagine, that within a comparatively short space, this man had been a puling infant. "The operations at present going on within him," complex and important as they are, would be altogether insufficient to carry back the mind to the first development of the germ, or forwards to the complete chemical

without, nor want a place where to cast out its superfluities. 'Tis satisfied with its own substance, its own space, and its own art." —*Meditations of Marcus Antoninus.*

This, too, reminds us of the Pythagorean doctrine as alluded to by the poet :—

> Tempus edax rerum, tuquæ invidiosa vetustas
> Omnia destruitis, vitiataquæ dentibus ævi
> Paulatim lenta consumitis omnia morte.
> Nec species sua cuique manet; rerumque novatrix
> Ex aliis alias reparat natura figuras.
> Nec perit in toto quicquam; mihi credite mundo
> Sed variat faciemque novat; nascique vocatur.
> Incipere esse aliud quam quod fuit ante,—morique
> Desinere illud idem. Cum sint huc forsitan illa
> Hæc translata illuc summa tamen omnia constant.
>
> OVID, *Metamorph.*

disorganization of the whole fabric. Nay, even in the starry firmament, there are symptoms of instability; and a mortal whose life is but a mere span, may sometimes catch a glimpse of systems changing, or a bright world, it may be, extinguished.*

* Such sudden appearance and disappearance of the stars are familiar to astronomers. It was the sudden appearance of a new star of uncommon brilliancy that first incited Tycho Brahè to the study of astronomy. The inferences in the following passage of Professor Playfair's "Illustrations," tend, however, to a somewhat different conclusion from the above. "How often the vicissitudes of decay and renovation have been repeated, it is not for us to determine; they constitute a series of which we neither see the beginning nor the end,—a circumstance that accords with what is known concerning other parts of the economy of the world. In the planetary motions, where geometry has carried the eye so far both into the future and the past, we discover no mark either of the commencement or the termination of the present order. It is unreasonable, indeed, to suppose, that such marks should any where exist. The Author of Nature has not given laws to the universe, which, like the institutions of men, carry in themselves the elements of their own destruction; he has not permitted in his works any symptom of infancy or of old age, or any sign by which we may estimate either their future or their past duration. He may put an end—as he, no doubt, gave a beginning—to the present system at some determinate period; but we may safely conclude, that this great catastrophe will not be brought about by any of the laws now existing, and that it is not indicated by any thing which we perceive."

PART II.

GEOLOGICAL PHENOMENA COMPARED WITH THE MOSAICAL RECORD.

In the beginning God created the heaven and the earth, and the earth was without form, and void, and darkness was upon the face of the deep, and the Spirit of God moved upon the face of the waters.—*Gen.* i. 1, 2.

In six days the Lord made heaven and earth, the sea, and all that in them is, and rested the seventh day.—*Exod.* xx. 11.

Thus the heavens and the earth were finished, and all the host of them: and on the seventh day God ended his work.—*Gen.* ii. 1, 2.

In the six hundredth year of Noah's life, in the second month, the seventeenth day of the month, the same day were all the fountains of the great deep broken up, and the windows of heaven were opened. And the waters prevailed exceedingly upon the earth; and all the high hills that were under the whole heaven were covered. And every living substance was destroyed which was upon the face of the ground, both man, and cattle, and the creeping things, and the fowl of heaven.—*Gen.* vii. 11, 19, 23.

SECTION I.

THE MOSAICAL AND GEOLOGICAL VIEWS OF CREATION.

If a stranger were to visit, for the first time, the ruins of Pompeii, without any knowledge of its previous history, he would view with interest the numerous fragments of most elaborate architecture strewed in ruins, and, struck with the still and silent antiquity of the scene before him, compared to the lively and luxuriant country around, his first impulse would be to inquire whether any tradition of this catastrophe existed. And thus it is, that the geologist turns from the contemplation of vast creative power, and of destruction and desolation every where around him, to ask of history, if it can throw any gleam of light on his perplexing meditations.

With the exception of national traditions and legends, which are all traceable to one common source, the Book of Genesis contains the only record of creation given to man. We do not deem

it necessary here to enter into any proof of the authenticity of the Mosaical history; but assume the fact as granted, that this account, brief as it is, is a genuine detail of the creation of the world.*

Unlike every other part of Sacred Scripture, which is entirely of a moral tendency, this is strictly a description of physical nature, and seems appropriately to have been given preparatory to a detail of the moral destinies of the human race; and though brief, is precise, as to the manner in which the world and all things it contains were created by the special operations of a great First Cause. This seemed necessary, lest notions, such as were broached among the ancient philosophers, of the fortuitous production of the world, from a chaos of atoms existing from all eternity, should gain general credence among the human race.

On entering on this subject, we must notice an

* Conjectures have been formed whether Moses delivered his history of the creation from immediate inspiration, or whether he derived his knowledge of the facts from the Egyptians, who again had the tradition delivered through the Chaldæans, from the offspring of Noah. We have no means of stating any thing but conjectures on this subject, nor is the decision of the question of material moment. Our faith in the genuineness of the narrative is corroborated by its recognition by every subsequent inspired writer, and by the great founder of Christianity.

The Passover of the Jews has been instanced as a test of Moses's veracity as a historian, — the observance of this event through subsequent ages being an indubitable proof of the actual occurrence which gave rise to it.

objection which has been frequently urged,—that as Revelation was evidently not intended to disclose a system of science, it is unwise to try geological facts by the test of Scripture. But if the Mosaical account of creation be not strictly and exclusively a statement of physical facts, it is nothing; and if the facts of Geology and the statements of Moses, when brought to bear upon each other, be not found to coincide, one of them must be false, or there must be something wrong in the mode of their conception, or the manner of their application. Two circumstances, however, are necessary, before a perfect and harmonious coincidence of both can be acquired.

We must, first, have a complete and accurate collection of the facts of Geology, and

We must have a precise and definite conception of the statements of Moses.

With this understanding of the matter, we now proceed to apply the ascertained facts of Geology, so far as known, to the statements in Genesis.

In perusing the simple, but sublime commencement of the Holy Scriptures, where the successive acts of creation are recorded, what is the natural and obvious conception of the passages by the general reader, unsophisticated by preconceived notions or critical propensities? As these records were most certainly penned for the general mass of mankind, and delivered, no doubt, with the view that they

should be universally and easily understood, we conceive this is the question by which their true meaning should be tried, and not by verbal criticism, and forced constructions of half sentences, and isolated passages. For of whatever nature, or however simple, a writing may be, especially if that writing be in a dead language, apply the Proteus power of verbal criticism, and it becomes any thing or every thing. Take from, or add to a sentence, a single word or half a word, and, like a child's edifice of cards, it falls instantly to pieces, and you may rebuild it as your fancy pleases. Accordingly, among all the laborious verbal criticisms of the Hebrew text, there is not one but what seems to have darkened or perplexed the meaning of the original; but as, at least, two great systems of geological belief have grown out of these, we must examine each individually.

In order to prolong the period of creation, the Mosaical days were supposed not to be of the ordinary length of twenty-four hours, but to be capable of being extended to an indefinite period, — the Hebrew word *iom*, day, being susceptible, as in our own language, of two significations, meaning either a natural day, which is the most definite and usual signification; or, in a collective sense, signifying an era or period of time. This interpretation was early resorted to by some of the Christian Fathers, as Origen, St Augustin, and Bede. It was subse-

quently adopted by Whiston, and eagerly seized on by De Luc, Kirwan, and other Wernerian theorists, as favourable to their hypothesis of a periodical deposition of the strata from a universal ocean. Faber, adopting the opinion of De Luc, argues, that the seventh day, or Sabbath, which commenced immediately after the creation of the world, has not yet terminated; and therefore, as this day has had an extent of six thousand years, the other six days of creation could not have each been less than this period. Now, the "days" of Moses are exactly specified as consisting each of a morning and an evening; and that there may be no mistake, it is afterwards mentioned that the light was called day and the darkness night. Again, it is stated in Exodus as a reason for observing one day in the seven as a Sabbath, that "in six days the Lord made heaven and earth, and rested on the seventh day." It is evident, then, that the Jews, to whom Moses, in the first instance, wrote, must have understood his meaning in the literal sense, and not according to the acceptation of Faber, else they would never have observed a Sabbath of one day, if a period extending to the end of the world was meant and intended. It is true that the Mosaic narrative speaks of days before they were measured by the sun; and on this account, the first periods may be allowed to be more indefinite.*

* Note IX.

But, granting the days of Moses to be lengthened into periods as long as the geologist pleases, apply these to the phenomena of the earth's strata, and we shall find the reconcilement of appearances as impracticable as ever. Instead of the regular gradation thus implied in the long periods between the creation of vegetables and animals, and between the lower animals and the higher, we find, in the very lowermost fossiliferous strata, fishes and molluscous animals and plants, all mingled in one bed; and, in other strata, birds, and creeping things, and reptiles, and even quadrupeds, that had been living contemporaries, entombed side by side. In the oldest marine basins, we find indications of rivers that had flowed into the ocean, carrying plants and animals from a then existing dry land.* Indeed, in the secondary strata, strictly so called, it is not to be expected that we should find a key to the

* This theory of the regular succession of organic life, from the simplest plants to the most perfect, and from the least organized animals up to the most complicated, was of late a favourite fancy,—is even yet, in spite of daily proofs to the contrary, still fondly adhered to—and still tinges the observations and assumptions of many geologists. Brongniart fancied, that he had at last found in the earth's strata a complete *hortus siccus*, arranged by nature to his hands, and that he had nothing to do but read off the vegetations of successive epochs, beginning with the simplest lichens and mosses, and advancing to the tall cedar. Nor were zoologists wanting who followed in his wake, with a creation of animals, arranged according to the newest systems, from the zoophyte to the elephant.

records of creation; for these, as already stated, are evidently formations derived from previously existing continents.

The other theory is founded upon a supposition, that between the first general announcement of the creation of the heaven and the earth, and the subsequent detail of the six days' creation, a long period elapsed, and that the present system of things was re-constructed out of the ruins of a previous world. Opinions of this nature were early entertained by theologians, when their imaginations wandered into incomprehensible speculations about the creation of matter out of nothing. They fancied they enlightened the utter gloom hanging over this subject, by throwing back the process to an indefinite period; and for their purpose, readily found in the word *create* two different meanings, — one signifying an origination of matter out of nothing, and the other a modelling or forming of something out of previously existing materials. In later times, opinions of this kind have been adopted by Rosenmuller, Bishop Sumner, Dr Chalmers, and some of the most eminent geologists both of England and Germany.* They suppose that the first verse of Genesis — "In the beginning God created the heaven and the earth," — alludes to the creation of a pre-adamite world, where plants

* Note X.

and animals existed for a long and indefinite period; that this world was destroyed, and that the subsequent narrative relates to the creation or fitting up of our present earth, raised upon the ruins of the former one; that all the strata below our present diluvium, with the whole of its organic plants and animals, belonged to this previous world; and that the present system of things, with the introduction of man upon the earth, had its commencement, as Moses states, about five or six thousand years ago.

The question, then, is, will the first verses of Genesis bear this construction put upon them? Does the first sentence, "In the beginning God created the heaven and the earth," appear an isolated announcement of a previous creation, unconnected with the detail of a second creation, or "fitting up," which is to follow? or does it not at once suggest the plain, and obvious, and unequivocal meaning of a general announcement of the subject which is to follow — that all things were created by God? This, we think, is distinctly evident from the second verse: there is no interval of time, in the remotest manner, suggested; on the contrary, the narrator, without pause or interruption, proceeds to describe the state of things immediately after the first creation, — "And the earth was without form, and void, and darkness was upon the face of the deep; and the Spirit of God moved

upon the face of the waters." Now, is this a condition of the earth where plants and animals, having an organization and habits exactly similar to those of the present day, and, as we shall afterwards see, some of them identical with existing species, could have lived and flourished, in utter darkness, in a void without form, where only moved the spiritual essence of divinity? Or, we shall ask, is this a description which any consistent or faithful narrator could have made to follow a completely organized world, supposed to be indicated in the previous or introductory verse? Had the state of the earth, immediately after the announcement of creation, been passed over in silence by Moses, there might have been some slight room for interposing a previous world. But the filling up of this period, however long or short it was,—for this circumstance does not seem expressly indicated by the narrative—with a sufficiently vivid account of the chaotic, or dark and unfurnished condition of the earth, is, we think, decisive against any such construction of the narrative. As the history of Moses, then, evidently commences with the first formation of the world, and proceeds with a creation from the chaotic state to the last production, man, in a consecutive and uninterrupted narrative, we are bound to believe that this narrative includes every organized substance, found in whatever part of the earth, which must have been produced subsequent

to the announcements in the first and second verses of Genesis.

We hold, then, that the idea of pre-adamite strata containing organic remains, in whatever condition these strata are seen or may be discovered, whether arranged in the order of a first creation, or seen in the position of secondary deposits from this, is at total variance with the narrative of Moses, and was never meant to be implied in his words, or dreamt of by his predecessors or contemporaries. There are also geological objections to this theory of a previous world. If it was entirely distinct from the present earth in point of the period of its existence, and if it was completely overthrown at the time of the second creation, how does it happen that existing species are found in contemporary strata with extinct ones? A considerable number of well authenticated examples of this nature are familiar to geologists, and every day is adding to the list of those important discoveries*

How does it happen that the mastodon of America has been found in the superficial mud of the Ohio, with the contents of its stomach of half digested shrubs and leaves—or that extinct deer are found in the bottom of our mosses,—if the chaotic state of

* See Lyell on the tertiary formations; and an account of the discovery of the remains of a paleotherium in the same strata with the camel, cat, and monkey, in the north of India.—*Dr Falconer and Captain Cautly; Asiatic Journal*, 1837.

Moses, in verse second, or the raising of the mountains and dry land, and the subsidence of the waters of the ocean, in verse ninth, of the first chapter of Genesis, with all the accompanying change and turmoil of a second chaos and new creation, had taken place. The preservation of these extinct animals, under such a condition of things, would certainly appear surprising.

When we examine the perfect state of preservation of some of our most delicately formed fossil leaves and stems, lying almost on the surface of the uppermost strata—the pearly lustre of shells—the tender tissues of animals—or think that the entire carcass of the Siberian elephant should have remained with only a slight covering of mud and ice, with the flesh in such a state of preservation as to be fit food for bears and wolves, we would require strong facts and powerful reasonings to persuade us that these have survived through "millions of millions of ages," the wreck of ancient worlds, the dark period of chaos, and the various commotions incident to the formation of an entirely new world. And yet there is no alternative between this supposition and the theories in question. They will not admit even of a catastrophe, such as the deluge, to disturb the surface of the soil at any period, subsequent to the commencement of the present creation, and existing order of things.

But it may be said, and has been adduced as a strong point of argument for the theory in question, Why are the extinct animals and plants of such a peculiar and almost exclusive character? It might rather be asked, assuming the theories to be true, Why are the fossil remains not more distinct and extraordinary than they are? They have the same structure, indicate similar habits, belong to the same general classes into which recent organized beings have been divided, and indicate similar genera, some species identical, and many, with slight variations; while every recent discovery, as it adds to the hitherto small amount of ascertained fossils, is swelling the proportion of those that are identical with existing species. If the facts of geology, then, demand *an organized world* anterior in date to the present, we must renounce altogether the authority of Moses as it is generally interpreted and understood.

A third theory has been partly suggested by the earlier divines, which is somewhat a modification of the extension of the term, Day. Bishop Patrick, who, in his commentary on Genesis, written about one hundred and fifty years ago, at a period when he was less likely to be influenced by scientific prepossessions than at present, though even then his biblical emendations were prompted by the doubts and suggestions of the geologists, thus remarks on the second verse of the first chapter of Genesis:

"Moses, in the words *without form and void*, gives a description of that which the ancients called chaos, wherein the seeds and principles of all things were blended together, which was indeed the first of the works of God, who, as Moses shews us in the sequel, produced this beautiful world out of this chaos. How long all things continued in mere confusion, after the chaos was created, before this light was extracted from it, we are not told. It might be, for any thing that is here revealed, a great while; and all that time the mighty Spirit was making such motions in it as prepared, disposed, and ripened every part of it for such productions as were to appear successively in such spaces of time as are there afterwards mentioned by Moses, who informs us that after things were digested, and made ready to be wrought into form, God produced every day for six days together some creature or other till all was finished."

Bishop Horsley also remarks, "that the interval between the production of the matter of chaos, and the formation of light, is undescribed and unknown."*

Michaelis farther suggests, that the first four days of creation, previous to the visible introduction of the sun and moon, may have been elongated periods, as previous to the fifth and sixth days there was no definite measurement of time.

* Biblical Criticisms.

Other theorists and commentators entertain the opinion that the narrative of Moses may be couched in that figurative language which is common throughout some of the Scriptural writings; and that though the facts which he relates may be substantially true, yet that the narration is framed in that popular and pictorial style suited to the capacities of the general mass of men for whom it was intended.

But this is an extremely loose mode of reasoning indeed. The Scriptures must be held to contain matters of fact applicable to all men, of all intellects, otherwise they must lead only to error and delusion; and if we can conceive that it was the pleasure of the Divine Being to reveal to man so much of the origin of the world which he inhabits, as was deemed necessary, it is reasonable to suppose that it was just as easy to give that revelation simply and unequivocally as to clothe it in mystery and allegory. Nor indeed does the other parts of the book of Genesis partake of this character. It is, throughout, a plain, simple, and matter of fact history, with the names and dates given to a scrupulous nicety.

The utmost latitude, then, that the interpretation of the narrative of Moses will admit of, is, that an indefinite period of time may have elapsed between the first formation of the earth into a mass, and the commencement of the first of the days of creation,

when light was elicited.* In this period, the inorganic matter of the globe may have suffered change, but organized beings could have had no existence. In the four first days of creation, as morning and evening are not measured by the presence of the sun and moon, it is doubtful and unascertainable from the narrative whether day and night was exactly of the same length as the days and nights subsequently portioned out by the presence of those luminaries.

Assuming that there is room for making such interpretations as above, without doing violence to the Mosaic narrative, and supposing hypothetically that these interpretations are correct, what would be their bearing on geological phenomena?

The indefinite period implied in the second verse of Genesis during the chaotic, "or empty and void," state of the earth, would give time, if, at such a period it was required, for the formation to any given extent of the primary non-fossiliferous strata; but an elongation of the first four days of creation into epochs or eras would meet with the same contradiction in the secondary fossiliferous strata as taken notice of in section I. page 76. In how far this elongation of the first days of creation would have been applicable to the appearance of the earth's surface, as first constituted, it is

* Genesis, i. 1, 2.

vain to conjecture, as no portion of the globe has yet been found where there is any evidence of this primary condition; on the contrary, every part of the earth's strata hitherto examined evidently appears to have been formed out of previously existing dry land, and exhibits unequivocal proofs of having been a deposit in the bed of a former ocean.

The general tenor of the narrative of Moses seems, however, to imply a consecutive and uninterrupted process of creation from the first production of light to the establishment of man upon the earth.*

* Note XI.

SECTION II.

MOSAICAL AND GEOLOGICAL VIEWS OF THE DELUGE.

MAN, by his superior endowments, has been enabled to stamp on the periods through which he has existed, a physical and moral impression entirely different from the other organized beings by which he is surrounded, while his future destiny connects him with intelligences beyond this sublunary scene. Of other animals, generation succeeds to generation; they live and die, and occupy no page in the records of time; they originate nothing, they accumulate nothing, and we could have had no trace that they had ever been, were it not for the scattered remains of a few species which are left to attest their former existence. But of man we can trace the origin and progress from the first period of his creation to the present time. It is true we have no physical proofs of his existence previous to the era of the deluge, when the repeopling of the earth commenced a second time from the stock of Noah: we have no traces of a city older than that of Babel, built by

the mighty hunter Nimrod, in the plains of Shinar, a short period after the catastrophe of the deluge, or of its contemporary Nineveh: we have no hint even of a monarchy older than the great Assyrian, which existed about a thousand years after the deluge: yet these remote times have not passed altogether unknown, till tradition, joining the stream of history, brings us through the Egyptian, Grecian, and Roman dynasties. But of Babylon and Nineveh we have indications. In the ruins of those cities we have proofs not only of what they were—the elaborately constructed abodes of busy, active beings—but we have also a confirmation of those prophetic predictions of what they were to be, the mouldering remnants of desolate, solitary, and now barren regions—thus affording a two-fold confirmation of the truth and accuracy of inspired writ, and its intimate connection with the history of man, and the secular events of this world.*

Yet, previous to the deluge, there existed cities, the arts of industry were known, there were "artificers in brass and iron," as well as agriculturists, "such as dwell in tents, and have cattle."† This interval, too, between the creation of man and the deluge, amounted, according to the Septuagint calculation, to two thousand two hundred and forty two years, a sufficient period, joined to the extreme

* Note XII.

† Genesis, iv. 17—21.

longevity of the ancient patriarchs, to produce a large population. How should it be, then, that we can trace man by his works alone up to this period and no farther, and that all beyond is matter of history? In order to solve this difficulty we must first inquire what were the nature and effects of the deluge.

We find a tradition of this great catastrophe very generally existing among the nations of the earth. Not only do we trace it passing from one to the other of those anciently civilized states which were the means of diffusing knowledge and refinement over the world, but even in the most remote and barbarous tribes who had branched out from the parent stock at a very early period,—all retain more or less traditions of this extraordinary occurrence. Many of these accounts, it is true, are mixed up with the legends and fables of the peculiar races, but enough of the original remains to indicate that they all received the first impressions from one original source; thus affording evidence in an extraordinary manner, not only of the original fact of the deluge, but that all the nations of the earth must have had a common origin.

From Chaldea and Egypt the history of the deluge passed into Phenicia and Greece, where the subject was invested with the legendary and fabulous mythology of that imaginative people, and Noah merged into Deucalion. From Greece the

Romans derived similar traditions along with their other learning.

The Hindoos and Persians, nations immediately derived from or coeval with the Egyptians, among many catastrophes which their theology records, place the last destruction of the earth at a period coeval with the deluge of Noah, and in terms nearly allied to the details of Moses.

The Chinese, a people of very ancient establishment, keeping carefully aloof from all others, and of such peculiar features and manners as to lead us to suppose that they branched off almost immediately from the family of Noah, possess also unequivocal traces of a "deluge said to be caused by Yoa their king, who let loose the waters, which bathed the feet even of the highest mountains, covered the less elevated hills, and rendered the plains impassable." The period of this deluge, too, remarkably coincides with that of the Hindoo traditions.

Among the Mexicans of South America, Humboldt has discovered some hieroglyphics typical of a deluge. And among the South Sea Islanders, — the extreme wanderers of the human race, who have scattered themselves over those more recently formed islands, which rise up as myriads of green specks in a vast ocean, — Ellis has distinctly recognized legends bearing upon this catastrophe.

Moses, who flourished a thousand years after the

event, relates the circumstances of the deluge with considerable minuteness. The year, month, and day of its commencement are stated, (Genesis, vii. 11.) Its object, too, is particularly announced —to destroy from off the face of the earth every living substance that had been created; and immediately following, in verse 13, it would appear, that not only men and animals, but even the solid earth itself was "destroyed." "And God said unto Noah, The end of all flesh is come before me, for the earth is filled with violence through them, *and, behold, I will destroy them with the earth.*" For this purpose, "the fountains of the great deep were opened up, and the windows of heaven were opened, and the rain was upon the earth forty days and forty nights. And the waters prevailed exceedingly upon the earth, and all the high hills that were under the whole heavens were covered. Fifteen cubits upward did the waters prevail. And all flesh died that moved upon the earth, both of fowl, and of cattle, and of beast, and of every creeping thing that creepeth upon the earth, and every man. And the waters prevailed upon the earth an hundred and fifty days." From this period, we are told, the waters gradually subsided, till, at the end of the twelfth month, Noah descended from the ark. That this was a general inundation and destruction of the then habitable earth, seems to be implied by the comprehensive terms in which it is expressed. Had it only been partial, and confined

to the localities then possessed by mankind, the precaution of saving the animals of a district would seem unnecessary, when a supply might have been obtained in adjacent countries. The general and obvious interpretation of the narrative, then, has been that of a total destruction of the then habitable earth. Such was the general impression of the Jews, as we learn from Josephus and Philo. In this light, too, it is alluded to by the ancient prophets and evangelists.*

We now turn to the inquiry, whether geology presents any proofs of these historical records. In the earlier stages of the sciences, almost every appearance in the earth's strata was ascribed to the action of the deluge, — the formation of rocks, the presence of marine shells, and the bodies of animals strewed in the soil and gravel. After the indubitable circumstance was ascertained, however, that the whole of the existing strata, surveyed by geologists, had at one time formed the bottom of an ancient ocean, a new light was thrown upon the subject, and the deluge, hitherto employed as a powerful and universal agent, sunk greatly in public estimation, and by many has been entirely discarded; while those who still seek for its indications, confine their views almost entirely to the superficial clay, mud, and gravelly deposits called diluvium.

This diluvial covering is universal over the

* Note XIII.

globe. It is found superimposed on every kind of strata, to whatever series that strata may belong; and though it may thin off in some places, so as scarcely to be perceptible, yet the portions so denuded will be found to have yielded their share of the diluvial matter to some adjoining hollow or valley.

Though generally of a clayey or sandy composition, it varies in many localities, partaking of the nature of the debris of the surrounding districts. Boulders, or round masses of rocks, of various sizes, often transported from hundreds of miles distance, are also abundant, mingled with smaller gravel and fragments of rocks. It contains also, in greater or less abundance, the bones of quadrupeds and other terrestrial animals, both of extinct and existing species. Bones of the elephant, mammoth, rhinoceros, hyena, ox, deer, horse, &c. are abundantly found in Britain, and on the continents of Europe and Asia. The mastodon, megatherium, and opossum tribe, are mingled with others in America; and New Holland contains bones belonging to the marsupial class of animals, mingled with fossil remains common to the old continents. The relative ages of this diluvial matter, in the different regions of the globe, or even in different parts of the same country, is still a subject unascertained by geologists; but the similarity of its general remains in all countries,

according to the usual test applied to the underlying formations, should claim for it something of a contemporaneous deposition.

In many situations it can be proved to have been accumluated at a period immediately following the upheaving of the strata, above which it is deposited, and immediately, or at a comparatively short interval, preceding the commencement of the present soil and vegetation.*

While some, then, believe this diluvium to have been the effect of the Noachian deluge, and to consist chiefly of the loose soil of the first formed continents, swept away and deposited on the strata elevated from the bed of the ocean by extensive volcanic convulsions of the globe at that period, others consider it the ruins of an antecedent world, which had an existence previous to the creation of the present. A third party, again, deny any universal or general cataclysm of the kind, and look upon the diluvial matter as a partial formation, deposited at different and long distant periods. As this theory does not demand a reconcilement with the Mosaical history, it is unnecessary to notice it farther here.

But to those who hold the opinion, that the Mosaic creation begins to be first indicated by our vegetable soil lying immediately above the

* See Remarks on the Diluvium around Edinburgh, p. 33; and illustrative section, note I. at the end of the volume.

diluvium, and that all below are the ruins of another world, we would just ask, where are the indications of the deluge? If, as Moses relates, all living beings then existing, the accumulated increase of two thousand years, were destroyed, where are their remains, or the indications of the waters prevailing over the earth for nearly twelve months? It may be replied, that the chief locality of the "flood" cannot yet have been discovered, as no well authenticated human remains have hitherto been found; but every region of the earth has now been sufficiently explored, where plants, and animals, or man, could have had an existence, according to this supposed theory, and yet no traces of a desolated world can be shewn, if we except a few stags' horns in peat mosses, and a few fresh water shells in our evidently recent and alluvial deposits. If "all flesh was destroyed with the earth," the catastrophe was not surely of that placid nature that it left no traces behind. Yet some have entertained this opinion. Linnæus says, he could see no traces of a universal deluge. Dr Fleming, in an elaborate refutation of Professor Buckland's "Proofs of a Deluge," declares, that to behold any such proofs would be repugnant to his belief of the sacred records; and Dr Buckland, after having devoted an octavo to the proofs of this catastrophe, renounces his former opinions in a short note to his later treatise on geology. Cuvier, on the

other hand, agrees with De Luc and Dolomieu, that no circumstance in geology can be more fully established than the fact of a universal catastrophe, corresponding to the period of the Mosaical deluge, having caused a complete revolution on the surface of the globe.*

There is certainly no necessity that Geology should supply a confirmation of the Mosaic testimony of the deluge. We are not led to look for such proofs in this testimony. It is a matter of belief, resting entirely on its own merits; and it is, perhaps, unwise to press immaturely what is not absolutely required. Yet, since ever Geology dawned as a science, it has been one of the strongest and most exciting impulses to its prosecution, to glean from its discoveries some information regarding this, one of the most singular, to us incomprehensible and astounding dispensations of Omnipotence, —the destruction of a world yet almost in the infancy of its being.

What strengthens the belief of a change and alteration, and perhaps a submergence more or less entire of the existing dry land at the period of the deluge, is the total absence of all physical traces of human beings anterior to that period. We can trace mankind by their labours, up to nearly the epoch of the deluge, and many appearances of the earth's

* Note XIV.

surface indicate the commencement of the present system of things about that period; but beyond this, all is darkness and uncertainty. We have not yet picked up a single human relic which can, with any degree of probability, be assigned to the generations of human beings that inhabited the earth for a period, at the average calculation, amounting to nearly two thousand years.

There are evidences in the earth's strata, too, assuming that these strata are not of an anterior world, but belong to the present creation, which would indicate a very general and violent change, corresponding to a complete remodelling of the earth at the period of the commencement of the present system of things.

Thus, there are indications of a sudden change of climate — of the extinction of a system of vegetable and animal life, extending over a considerable portion of the globe, which seemed to have consisted of a more uniform nature than the diversified systems which now find a place over the same regions— of the sudden deposition of diluvial matter over the strata, forcibly elevated from the ocean, and immediately above this diluvial matter, the commencement of the present soil and present system of animal and vegetable life.

Neither are we assured of the actual duration of the antediluvian period, for the different versions of Scripture assume different dates. Thus, the three

oldest versions known give the following dates to the period of the deluge and age of the world.

From the creation to the deluge.	
Hebrew text,	1656 years
Samaritan,	1307
Septuagint,	2242
From the creation to the birth of Christ.	
Hebrew text,	3760
Usher,	4004
Hales,	5411
Josephus,	5402

Although Moses mentions years, months, and days, in relating the incidents of the period, yet we know not accurately the system of his computation of time. In these versions of Scripture, there is a discrepancy of this kind,—the Samaritan computing ten months to a year, while the others reckon twelve.

We can glean little either of the particulars of this singular period. The duration of life greatly exceeded the average of the present,—a necessary provision to people an infant world. The period of puberty, too, seems to have been greatly extended, if we may judge from the circumstance that, in the majority of cases, one hundred years elapsed before marriage. The physical stature is said to have been, at least among some families, gigantic; and other circumstances are remotely alluded to, which cannot now be readily explained. Moses passes

rapidly over the period, and gives only a meagre chronology of the patriarchs, and of a race of people who flourished during a longer era than that of any of the subsequent dynasties of the earth. What was their moral code, their laws, their pursuits, is but dimly hinted at; so that, altogether, this period, in its physical arrangements, civil and moral constitution, and destiny, must have formed a distinct and peculiar dispensation.

Concluding that the deluge was to the extent of destroying every living thing with the earth, or surface of the earth, as implied in the narrative of Moses, and assuming that its effects are indicated throughout a considerable portion of the globe, the catastrophe may have been produced by natural operations, or a special cause,—that is, the operations periodically taking place on the surface of the globe —such as the sudden overflow of rivers and bursting of lakes, or the sinking and submergence of dry land from volcanic action, may have acted both with increased intensity and enlarged extent of operation; or some special cause may have been employed for this specific purpose, which is not to be repeated, and which, therefore, remains a miracle unknown and inexplicable.

The natural phenomena of evaporation and rain would not account for the deluge; because, the utmost quantity of moisture which the whole atmosphere can contain, if suddenly deposited, would not

amount to more than seven inches over the surface. Even supposing this evaporation and descent of moisture to be for the period incessant, the drainage by rivers and hollow valleys would still keep a considerable portion of the surface dry.

The phenomena of volcanic action elevating a large portion of the bed of the ocean into dry land, and submerging other portions of former continents, would approximate nearer to the supposed catastrophe of the deluge. The temporary increase of heat from the extensive volcanic action, might keep up a prodigiously increased evaporation; and thus rain would descend over the surface of the globe in torrents, and aid the effects of currents and diluvial waves, supposed to be indicated on the present surface.

Such hypothetical operations might be advanced to explain this singular phenomenon; and yet, perhaps, as respects the actual occurrence, they may be as visionary as the celebrated shock of a comet, which was once a favourite explanation.

One other mode of accounting for the deluge may be here alluded to. From the evident change of temperature, and the marks of convulsion which appear suddenly to have taken place at a certain period of the earth's history, it has been supposed that the axis of rotation of the globe has been changed—thus changing the position of the equator, and consequently the zones of temperature. One

great objection to this theory, is the oblate spheroidal figure of the earth indicating a swelling out at the equator, which must have been produced at the beginning, and which could not have been changed at the supposed alteration of the axis of rotation. Even had an accumulation of debris about the new equator supplied the necessary elevation, still indications of the old elevation would, in all probability, be somewhere visible. Another objection is, that appearances in the fossil floras of every region indicate, at one period, an almost universal elevation, or rather equalization of temperature over the globe, which would be incompatible with the theory of the change of the axis of rotation.

One conclusion, in a historical view of the deluge, is, however, evident,—that the catastrophe differed from an ordinary event of nature, in so far that it is expressly promised that it shall never occur again. Had it been a natural overflow of lakes or rivers, or a long continued rain simply, such as had taken place before or might happen again, even though to the partial loss of animals and men, this great general assurance held out prospectively to the whole human race would not have been so emphatically given.

In speculating on the deluge, however, we must bear in mind that it was a supernatural event, and though it may have been in a great measure

34128

caused by natural operations, yet we are entirely ignorant of the manner of its accomplishment. For this reason there are circumstances attending it which must be to us inexplicable—such as the reinvesting the new surface of the earth with plants — the verdant condition of the olive tree, immediately on the cessation of the waters — the miraculous preservation of every terrestrial animal, &c. As we have no facts or analogies in nature to guide us in such operations, any attempted explanation of them would be preposterous.

In whatever way we connect the history of the deluge with the phenomena of disturbance and change, which evidently seem to have ushered in the present system of things, one conclusion is obvious from these,—that the world has not gone on in an unvaried course, since the beginning of time —that to-day has not been always as yesterday—or that the same uninterrupted succession of events has not regularly followed each other. We evidently witness the effects of violent and sudden causes, and if to-day has not been as yesterday, so to-morrow may not continue as to-day; strange revolutions have been, and there may yet be stranger.

"There shall come in the last days scoffers, saying, All things continue as they were from the beginning of creation. For this they willingly are ignorant of, that, by the word of God, the heavens

were of old, and the earth standing out of the water and in the water: whereby the world that then was, being overflowed with water, perished: but the heavens and the earth which are now, by the same word, are kept in store, reserved unto fire against the day of judgment and perdition of ungodly men." 2 Peter, iii. 3—7.

It is, perhaps, presumptuous to hazard a single comment on this passage; yet the volcanic theory of Davy points out the cause of "fire" as existing probably at no great depth below the surface,—the "elements of things" reposing quiescent, or only partially disturbed, and forming the base of this verdant animated crust, yet ready at a word to enter into combined action, and melt into one glowing mass the terraqueous sphere. Fancy, too, might vaguely speculate whether the matter of the globe shall be annihilated, or dispersed and scattered to the four winds of heaven—whether another earth shall phœnix-like rise out of the ruins, and what aspect this new world shall bear; whether it shall be a more genial and perfect habitation than the present, with verdant valleys, and calm breezes—the abodes of beatified saints, or new existences of more perfect and obedient natures, without sin and without suffering; or whether it will be of a more rugged and terrible aspect—now flaming with scorching heat, and now freezing with deadly congellation—the prison—the hell of irreclaimable beings—where

no redeeming virtues may blend with or soften the savageness of vice, but where reckless depravity shall reign triumphant!

The very limited duration of the earth was an opinion prevalent among the Jews before the birth of Christ, and was adopted by the apostles, and many of the early Christian fathers. Barnabas, the pupil and immediate successor of St Paul, entertained this opinion, and we find traces of the same belief of a speedy termination of the world, in the works of Justin Martyr, Tertullian, and St Cyprian. Lactantius, who lived in the fourth century of the Christian era, thus writes, — "Quando tamen compleatur hœc summa, (6000 ann.) docent ii qui temporibus scripserunt, colligentes ex litteris sacris et ex variis historiis, quantus sit numrus annorum ab exordio mundi. Qui licet varient et aliquantum numeri eorum summa dissentiat; omnis tamen expectatio non amplius quam ducentorum videtur annorum." *

Time has, of course, shewn all these opinions to have been fanciful. Nor is there in revelation the slightest data for making any calculation of the

* At what time this period of six thousand years shall be completed, they inform us who have written of those periods, collecting from the Sacred Scriptures, and other sources, what is the number of years from the commencement of the world. And although there be some discrepancy amongst these, yet the general computation does not exceed two hundred years.—*Divin. Institut.* Lib. vii.

kind. As there are physical circumstances, however, which prevent us from contemplating the stability of the present surface of the globe for an indefinite period, (alluded to in Part I. sec. vii.) so certain moral suggestions present themselves to the mind, as if the present system of things might only have a continuance in some sort proportioned to the period which has already elapsed.

Of this kind are the gradual fulfilment of the ancient prophecies, and the bringing in of the Jews previous to the final accomplishment of all things.

For it would be somewhat difficult to imagine that this singular remnant of an ancient race could remain distinct, through millions of millions of generations yet to come. The very lapse of such periods as these, too, accumulating the annals of myriads of dynasties, on a mind so limited and circumscribed as is the human—the diversities of creeds, the taints of superstition, the casualties of language and written records, and the immense distance to which it would throw back the sacred events, so fresh and momentous to men as at present contemplated,—would, on a general view of this subject, almost compel us to anticipate a more limited consummation. And yet the past teaches us remedies for even such indefinite extension. The march of civilization, though, on the whole, perhaps, tending to progression, yet suffers singular revolutions and interruptions. The migra-

tion of mankind, the diversities of language, the feuds and animosities excited by selfish ambition, and the national antipathies which these engender, are all causes conducive to these interruptions and retardations. In the history of nations, how many periods of utter darkness have succeeded to short gleams of light—and how often has the accumulated labours of ages been swept into oblivion, and man has been left to build up the structure of science and of facts almost anew. What a drawback on the interchange and progress of knowledge is the diversity of language alone. Yet this seeming obstruction may, in reality, be some great safety valve in the machinery of human existence.

SECTION III.

GENERAL SUMMARY.

We have thus endeavoured to shew in how far the disintegrating causes at present in operation may have been sufficient, in former periods, to have accumulated the existing strata of the earth within a moderate period of time, especially if we have grounds for supposing that these causes in the early history of the globe may have acted under more favourable circumstances for such accumulation than at present.

We have shewn, too, that there is considerable difficulty in estimating the actual thickness of many of the stratified beds; that great inequality takes place in them, often occasioned by drifting of rivers and currents; and that the extreme depth is more frequently estimated than the average; while, as in relation to the elevated surface of the crust of the globe, the stratified rocks bear an exceedingly small proportion to the great masses of igneous formation, which have been the actual cause of the elevation of the surface above the level of the ocean.

Considering, too, that all the strata hitherto examined bear evident indications of having been deposited from previously existing continents and seas, in which we have proofs that mountains, rivers, plants, and terrestrial as well as marine animals existed, we can have no direct proofs of their relative ages, except in those cases where the one is superimposed upon the other; so that many groups which are not thus superimposed may have had a contemporaneous formation.

That, for the same reason, the hypothetical assumption of the successive creations of animals found occupying the different formations and various beds of the same strata, is unphilosophical; because, in the first place, unsupported by the facts and analogies of nature; and, in the second place, because their mere superposition in strata, in any given locality, does not preclude the probability of their having existed conjointly and contemporaneously in other situations.

We have next shortly considered whether there are sufficient data in the appearances of the existing surface of the earth in different parts of the globe, to warrant the conclusion that our continents and islands have been elevated to their present levels at different epochs, so that some of these are of infinitely older dates than others; or whether the present system of things over the surface generally, has commenced at one period.

In the second part, we have considered the Mosaical record, and its various interpretations as applied to Geology.

We have shewn that, in whatever sense we take the Scripture history, the Mosaic account of creation cannot be applied to the earth's strata as they now exist, because we no longer behold the earth as at first formed, but after it has been destroyed and again remodelled. But though we are thus so far deficient in geological data to confirm the narrative of creation, yet there is nothing in what remains that offers a shadow of contradiction to that wonderful intimation of events; on the contrary, there are circumstances which, to many minds, afford strong confirmation of its accuracy. All theories, therefore, built upon the facts of Geology, must as yet—and, it may be, for ever—be imperfect, because we are only conversant with half the facts. We know only the secondary world—the first is, perhaps, for ever beyond our reach. For, let us suppose for a moment, that all the existing continents of the earth, and all records of them were destroyed, and that no portion of dry land was saved, but a few coral islands in the South Seas, with their small allotment of plants, animals, and men; and suppose that some of these Polynesian geologists set about forming a theory of the earth: they would examine and measure accurately the coral rocks, which formed the base of their islands,

would compare their formation with similar processes going on in the seas around, and calculating to a nicety the time taken by the living zoophytes to build up so many feet of shelly walls, they would apply the test to their own islands; and thus, by facts, to them indubitable, because no other existing facts remained to contradict them, would they pronounce the world to be only one or two hundred years old. Suppose that to these geologists the narrative of Moses was presented, yet with such strong facts before them, and without the correcting knowledge of intervening history or phenomena, how could the human mind be supposed readily to bend from its proud heights of inductive reasoning, to the humble belief of a remote and irreconcileable narrative?

But even supposing that the surface of the earth, as at first created and furnished with plants and animals, were still preserved to us, and fully exposed to our investigations; it is more than probable, that still we could glean nothing satisfactory of causes from mere physical appearances. Because the creative process must have been an operation totally different from all the other subsequent phenomena of nature, the effect of a cause which has now ceased to operate.

It is thus that the human mind is in a singular predicament, limited as to its power of conceiving scientific truth, and only partially furnished with the revelation of Divine. To attempt, then, to come

to a final decision, on a point where these two imperfections meet, is worse than illusory. Our resting point here cannot be gained through the operation of reason, but of faith alone.

May we not be permitted to think, then, that the period for forming a true theory of the earth has not yet arrived, and may never come — that we must content ourselves in this, as in most other cases of human inquiry, with an investigation of facts and phenomena, without diving into causes which are to us inscrutable? Or if theories are required, let them be of the temporary and avowed nature of hypotheses, not the dogmatical assumptions of hasty and inconclusive reasonings. Nor, after all, is a theory, however ingeniously contrived, the greatest achievement of a powerful intellect. Superficial minds are easily satisfied with the nearest resting place, like the shallow pool which quickly subsides after its surface has been agitated; while the deep mass of waters once excited, rolls on, wave after wave, until it reaches the stable shores of truth and certainty. Nor is the simplest and readiest way of accounting for things always the most compatible with the laws of nature and truth. Is the assumption of the phlogiston of Stahl, equal to the beautiful inductive proof of the existence of oxygen by the experiments of Lavoisier; or the vortices of Des Cartes like the exposition of the laws of attraction of Newton? We may be at a loss to account for

the production of certain phenomena, but calling in a million of years to our assistance will not render the matter more plain; and if we find certain organized bodies where we previously conceived they should not be, the bringing down a Deity for their special creation is contrary to all rules of epic, as well as philosophical propriety. A great mind can derive a serene pleasure from suspense—can remain poised in a delicate equilibrium between truth and uncertainty — can dally with fond surmises; and there are conjectures which may be thought, not uttered. But doubt to the multitude of minds is torture. They must rush to conclusions through whatever channel; so that, the bane of theorizing does not cease with the few first originating minds, but goes downwards to tinge, it may be to poison, the succeeding generation; for nothing is more true, than that "the prejudices of the multitude are but the cast-off clothes of philosophers."

The intellect of the present age has been characterized as acute, discriminating, active, and energetic, in the pursuit of facts; but loose, illogical, and inconclusive in the application of them. If we glance at the theoretical geologies of the day, these characteristics could not, perhaps, be more happily applied. Even the diversity and the quick succession of these theories implies this; for they cannot all be correct, nor can a man's previous opinion be valued when it becomes the reverse of his present

one. Every other while a new position is taken up; and, like the ascent of an Alpine country, when one summit is gained, which at the time appears the chief eminence, another and another still appears towering behind.

How often, too, do we find theories tinging facts; or, at all events, so fixing the axis of vision, as to make all facts be disregarded, except those particularly looked for.

Mr Whewell, in a passage which we have already partly quoted, observes:—"While so large a portion of the globe is geologically unexplored—while all the general views which are to extend our classifications satisfactorily, from one hemisphere to another, from one zone to another, are still unformed—while the *organic fossils of the tropics are almost unknown*, and their general relations to the existing state of things has not even been conjectured, how can we expect to speculate rightly and securely respecting the history of the whole of our globe? And if geological classification and description are thus imperfect, the knowledge of geological causes is still more so. As we have seen, the necessity and the method of constructing a science of such causes are only just beginning to be perceived. Here, then, is the point where the labours of geologists may be usefully applied, and not in premature attempts to decide the wisest and abstrusest questions which the human mind can propose to itself. It

has been stated, that when the Geological Society of London was formed, their professed object was to multiply and record observations, and patiently to await the result at some future time; and their favourite maxim was, it is added, that the time was not yet come for a general system of geology. This was a wise and philosophical temper, and a due appreciation of their position. And even now their task is not yet finished — their mission is not yet accomplished: they have still much to do in the way of collecting facts, and in entering upon the exact estimation of causes — they have only just thrown open the door of a vast labyrinth which it may employ many generations to traverse, but which they must needs explore before they can penetrate to the oracular chamber of truth." *

It becomes a question of importance, then, how far those unsettled notions of the antiquity of the earth bear upon our acceptation of revelation. It is true, even the Mosaical record does not definitely settle this question; for, besides the difficulties of interpretation, there is also an uncertainty of chronological data; yet the most obvious and general impression of these revelations on the human mind cannot be mistaken or controverted— That the world was created and furnished with plants and animals for the express habitation of

* Whewell's History of the Inductive Sciences, vol. iii. pp. 621, 2.

man within a definite period; that, after a time, it suffered a partial destruction and change by some great catastrophe; and that, ultimately, it will be totally destroyed, after it has ceased to be needed as the theatre of moral probation for the human race. Now, if instead of this we are led to believe that the earth bears traces of incalculable antiquity—that it was formed out of the wreck of a former world which had existed for millions of millions of ages with intelligences no higher than that of Mastodons—that we can find no traces of a catastrophe corresponding to the Noachian deluge—and in place of the final destruction of the earth, that we see in it nothing but powers of perpetual and infinite renovation, — we are startled with the discrepancy, and either doubt the authenticity of the Mosaic narrative, or become distrustful of the assumptions which thus go to contradict it.

It is quite possible that some minds are so happily constituted as to derive exalted notions of the Deity in whatever way they contemplate his operations; and that their admiration of his power, and wisdom, and benignity, may be as intensely excited from peculiar views of his works, which militate against their preconceived notions of revelation, as if they entirely corroborated them; their facile faith easily adjusting the seeming inconsistencies. But to the generality of beings, such a delicate vacillation of the balance is impracticable: they must either lean

to one side or the other. A celebrated geologist has observed, "that superficial geological learning may lead the mind from the Holy Scriptures, but a thorough knowledge will lead it back.* To those half informed minds the most novel and startling theories are always the most acceptable. To the young especially an eccentric tract has always peculiar charms. They will follow a bold and fearless, though, it may be, a bungling leader with all the ardour of their constitutions, and leave the cautious and laborious investigator behind. There is a craving after scepticism which seems to be a concomitant of the crude intellect, just as we find some disordered dyspeptics cramming themselves with chalk and clay.†

* Professor Buckland's Inaugural Lecture.

† Natural theology appears, even in its highest acquirements, to be only a faint gleam reflected from the torch of revealed truth. And were it not for the existence of this latter, it is probable that even the highest intellect would soar little above a New Holland savage. The connection of philosophy and revelation, then, seems so far to be indispensable; and in investigations of final causes, beyond the mere phenomena of nature, the one must terminate in the other. Nor can we allow that revelation does not, in many important questions, bear upon physical science. Can science, for instance, demonstrate the immortality of the soul? Is this conception innate? Or without revelation could unassisted reason have ever dreamt of a future state of existence? Let us only think what would have been the state of this question without the aid of revelation, where all the physical facts are decidedly in favour of the materialist.

We know nothing of the origination of language, or of letters,

Such, too, is the rapid spread of novel opinion, that the boundless antiquity of the earth is now incorporated into the superficial jargon of the day. Every propounder of a system now prefaces it with the progressive stages of the world's growth, and draws largely in his analogies on the tardy development of the operations of Omnipotence; and when a check is offered to his crude and inconclusive conceptions, he fancies himself another Galileo, and glories in his imagined martyrdom. Yet no case was ever more exaggerated than that of Galileo; and even assuming it in its worst phase, it was rather the fault of the age than of the individuals engaged in it. How many really wicked attacks have been levelled at sacred things from the days of Galileo to the present, and successfully refuted by divines, laudably on the watch to preserve the purity of that faith which has been intrusted to them, and yet how small praise has been awarded them, compared to the opprobrium of this one case of exaggerated oppression! Even our modern cosmogonists

or moral and civil codes; for, as a recent author (Whewell) remarks, nothing similar seems to be taking place in the world at present. In short, man, if left to his own resources, would seem little calculated to raise himself much above the brutes; for examples of this are not wanting in tribes and nations which have degenerated into extreme barbarism; and many of the ancient philosophers exhibit proofs of the profound depths to which acute minds will flounder "in wandering mazes lost," without the light of a superior guiding star.

triumphantly appeal to this, although the Galileon heresy has nothing in common with their objectionable theories in thus far,—that the most remote revelation of astronomical truths would have been foreign to the very purpose of our limited and probationary state, while, on the other hand, a distinct revelation, so far, of the origin of the world and its physical history, was necessary to the understanding of man's moral condition and prospects. In the former case, the common language, descriptive of phenomena as they are seen, was necessarily made use of; in the latter, language expressly descriptive of the actual facts was indispensable.

But if revelation sometimes suffers from its friends, it is not surprising that it should do so from its avowed contemners. To those who search more eagerly for missiles to attack, than for weapons to strengthen and defend truth, it is not surprising that the most absurd and futile arguments are acceptable.

Of this nature was the imputed antiquity of the Chinese history and astronomy, since found to be a baseless fabric of fable; the long array of eclipses of the Hindoos, stretching into ages anterior to the Mosaic birth of the world, now ascertained to have been calculated backwards; or the famous Zodiac of Dendera, where the sun has a place in the ecliptic, that he could only have occupied many ages

before the creation, and which at first was supposed to be of great antiquity, but which has now turned out to be a bauble of the age of the last Cæsars. The successive cataclysms of the Hindoo cosmogonies, though made up of the most palpable inconsistencies and puerile absurdities, have also been brought prominently forward as a sanction for theories; while a record infinitely more ancient, and whose claims of authenticity demand for it at least the rank of an authority, has been lightly passed over.

Such, too, were the sage theories of Brydone,* by which he explained the more than antediluvian age of Etna, from the alternate layers of soil and vegetation which he fancied he saw enveloped in successive masses of lava, the result of eruptions of many thousand ages. For the first part of this notable discovery he declares he was indebted to an Italian ecclesiastic. "But the Canon Ricupero," says Dolomieu, "deserves neither the praises which have been bestowed upon his science, nor the doubts which have been raised concerning his orthodoxy. He died without any other affliction than that which was caused to him by the work of Mr Brydone. He could not conceive for what purpose this stranger, to whom he had rendered services, endeavoured to excite suspicions concerning

* Tour through Sicily and Malta.

the orthodoxy of his faith. This simple man, very religious, and attached to the faith of his forefathers, was far from admitting, as an evidence against the book of Genesis, pretended facts which are false, but from which, even if they had been true, nothing could have been concluded. *Vegetable earths between beds of lava do not exist,* and the argillaceous earths which are sometimes found between them, may have been deposited there by causes totally independent of the antiquity of Etna." Others take a fancy to dive into the iron mines of Elba, and there, by calculations of the waste produced by human labour, shew that the mines must have been wrought forty thousand years before the period of the Romans! A third meets with the Baobab tree (*Adansonia digitata*) in Africa, and perceiving that its concentric circles amount to more years than the world is reported to have existed, immediately sets it down as a witness against the narrative of Moses, without ever pausing to reflect that, in tropical regions, some dicotyledonous plants never shew indications of annular circles at all, while many have them very irregular; while it is far from improbable but that some species may produce more than one woody circle in a year. Some again take higher ground, and exhibiting a scheme of ceaseless operations of decay and reproduction, where there are no marks of beginning or end, easily get rid of the restraints of

history altogether, and freely exult in the fields of untrammeled speculation.

There seems in all this an impatience of monotonous truths, a desire of novelty, and a panting for singularity of opinion, regardless of all the more rigid rules of sound philosophy. A venerable author,* on this subject, thus writes, "It is now thirty-five years since my attention was first directed to these considerations. It was then the fashion for science and for a large part of the educated and inquisitive world, to rush into a disbelief of all written revelation, and several geological speculations were directed against it. But I have lived to see the most hostile of them destroyed by their as hostile successors, and to observe that nothing which was of this character, however plausible at the moment of its appearance, has had any duration in human estimation, *not even among the sceptical.*"—"Hence I continue in the belief, that whatever is true in fact and correct in inference, on the subject of geology, will be, in the end, found to be not inconsistent with the account of Moses, nor with the common meaning of the expressions he uses. There is certainly no appearance as yet that any contradictory theory will long survive its public annunciation. *Magna est Veritas et prevalebit* is the everlasting axiom. Truth and

* SHARON TURNER, *Sacred History of the world.* vol. i. p. 38.

truth only will obtain any immortality in the intellectual, and, therefore, in the literary and social world."

It cannot be denied, however, that if the propounders of theories have been unsuccessful in their attempts, those who have taken the field with the avowed intention of supporting the Mosaical record have no less signally failed. Perhaps there could not be a better proof of the difficulty—the almost impracticability of the subject—than the fact that so many learned, and able, and pious men have devoted much thought to its investigation, and yet have come to such different and often lame conclusions. It has not been with the presumption of devising any new or final solution of the dilemma that the foregoing pages have been written, but with a humble attempt to place the different parts of the subject within the view of the general inquirer and student of geology, and rather to enter a caveat against hasty conclusions, than to bring the reader to any secure and stable haven of certainty.

PART III.

SKETCH OF GEOLOGICAL THEORIES.

"Accustomed to trace the operation of general causes, and the exemplification of general laws, where the uninformed and uninquiring eye perceives neither novelty nor beauty, the Geologist walks in the midst of wonders; every object which falls in his way elucidates some principle, affords some instruction, and impresses him with a sense of harmony and order; while the observation of the calm, energetic regularity of Nature, the immense scale of her operations, and the certainty with which her ends are attained, tends irresistibly to tranquillize and reassure the mind, and render it less accessible to repining, selfish, and turbulent emotions."

SIR J. HERSCHELL *on the Study of Natural Philosophy.*

SECTION I.

EARLY HISTORY OF GEOLOGY.

GEOLOGY is a science of comparatively modern date, and does not seem to have occupied much of the attention of the early philosophers. The investigation of the earth had not that attraction to the first inquirers after knowledge which the kindred science of astronomy claimed. And this is not to be wondered at, for from the first hour when man cast his eyes upon the starry firmament, an intense desire to know something of the wonders of the undefined and magnificent scene before him must have taken possession of his mind; and it was not till after the curiosity had been somewhat satiated on this subject, and after considerable progress had been made in the investigation of the organized world of plants and animals, that philosophers began to turn their attention to the structure of the earth on which they dwelt.

Accordingly, among the early nations of mankind we find few traces of Geological research.

The Egyptian and Hindoo cosmogonies are pure fables, mixed up with their imaginative mythologies, and indicate little or no actual acquaintance with the phenomena of the earth's strata. The grotesque and fabulous legends of the Egyptian priests contrast strongly with the Mosaic narrative, and thus prove in an unequivocal manner that those could not have been the source from whence the sacred historian derived his information. Herodotus, who visited Egypt, relates to us the practical observations which he had gleaned from the priests themselves, and thus we learn the very limited and imperfect knowledge of which they were possessed. Pythagoras, who, to the knowledge which he had gleaned in Egypt and India, added the results of his own researches, appears, however, to have accumulated a considerable number of facts concerning the physical geography of the earth; and Ovid has probably embodied the greater part of these as well as the contemporary knowledge of his day in his Metamorphoses. The amount of this information, as collected by Mr Lyell, is,—

That land has been converted into sea, and sea has been changed into land, while marine shells are found far distant from the deep.

That valleys have been excavated by running water, and floods have washed down hills into the sea; that marshes have been drained, and dry land converted into stagnant pools.

That during earthquakes some springs have been dried up, and new ones have broken out; that rivers have deserted their channels, and have sprung up elsewhere, as the Erasinus in Greece, and Mysus in Asia.

That by the accumulation of deltas, islands have become connected with continents, as in the case of Antissa, joined to Lesbos, and Pharos to Egypt. On the other hand, peninsulas have been divided from the main land, and have become islands, as Leucadia, and according to tradition, Sicily.

By the agency of earthquakes the cities of Helici and Buris were submerged, while plains have been elevated into mountains.

He mentions the existence of thermal springs; some that convert substances into marble, and others that contain inflammable air. He also mentions volcanic craters — their varying eruptions — and the probable causes of their production.

Aristotle, in addition to the knowledge of his predecessors, also joined the results of his own acute and accurate observations. He particularly remarked the changes taking place on the earth's surface, and in some of the following statements would seem to have anticipated the theories of the present time. "The changes of the earth," he says, "are so slow in comparison to the duration of our lives, that they are overlooked; and the migrations of

people after great catastrophes, and their removal to other regions, cause the events to be forgotten.

"The distribution of land and sea in particular regions, does not endure throughout all time, but it becomes sea in those parts where it was land; and again, it becomes land where it was sea; and there is reason for thinking, that these changes take place according to a certain system, and within a certain period. As time never fails, and the universe is eternal, neither the Tanais nor the Nile can have flowed for ever. The places where they rise were once dry, and there is a limit to their operations, but there is none to Time. So also of all other rivers: they spring up and they perish; and the sea also continually deserts some lands, and invades others. The same tracts, therefore, of the earth are not, some always sea, and others always continents, but every thing changes in the course of time."

Among the Romans geology made little progress, and scarcely an original investigation is to be found in their annals. Pliny merely collected the facts of previous observers. The same remark applies to the Arabian writers of the middle ages, no new geological discoveries having been elicited by their labours, although they cultivated with some success the study of mineralogy. About the commencement of the sixteenth century, the Italians began to

turn their attention to this subject. In 1517, a number of fossil shells and petrifactions were dug up in repairing the city of Verona, and the singularity of these greatly attracted the public attention, and especially that of Fracastoro, who demonstrated that these remains had once been organized animals, that had lived and died on the spot where they were now entombed. Another opinion, however, prevailed at this time, that such fossils were merely produced in the earth by a "plastic force" of nature, and that they had no animal origin, and for several centuries afterwards, this argument occupied the sole attention of geological disputants. In 1669, Steno, a learned Dane, and professor at Padua, published a work on fossils, which also contained many original observations on the earth's strata, and an attempt to reconcile geological appearances with the narrative of Moses.

While geological discussions and investigations were thus exciting considerable interest in Italy, Germany, and France, the subject was taken up in England.

In 1678, Dr Plott, in his Natural History of Oxfordshire, discussed the theory of fossil shells, attributing their production to "a plastic virtue latent in the earth."

Dr Lister also published a work on recent and fossil shells, and supposed these latter to be either "terriginous, or, if otherwise, that the animals they

so exactly represent have become extinct." Lister was the first also who proposed the construction of geological maps.

In 1678, Leibnitz turned his "universal genius" to the subject of geology. In his "Protogœa," he supposes the earth to have been originally an incandescent mass, which gradually, in the course of time, cooled down, till the surface became sufficiently refrigerated to allow of the condensation of water, which formed a universal ocean. As the centre gradually cooled, various fissures and cavities were successively formed, into which the waters of the ocean subsided, leaving portions of dry land. During the intervals of disturbance and agitation, caused by these internal operations, the waters of the ocean deposited the various strata as they are now found irregularly arranged on the surface.

In 1668, Dr Hooke, a celebrated mathematician and lecturer on geology, left a posthumous work on earthquakes and fossil remains, in which he characterizes the latter as the medals of nature, by which he thought it might be possible to trace the various revolutions of the earth's strata. He was aware that these fossil remains were of different species from known animals, but he doubted whether the species had become extinct, considering that the knowledge of naturalists was yet very limited, especially regarding those animals that inhabit deep seas. In speculating on the extinction of species,

he suggests that there might be some connection between the disappearance of certain kinds of animals and plants, and the changes produced by earthquakes in former ages. Some species, he remarks, are peculiar to certain places, and not to be found elsewhere. If, then, such a place had been swallowed up, it is not improbable but that those animate beings may have been destroyed with it; and this may be true both of aërial and aquatic animals; for those animated bodies, whether vegetables or animals, which were naturally nourished or refreshed by the air, would be destroyed by the water. Turtles, and such large animals as are found in Portland, seem to have been the productions of hotter countries; and it is necessary to suppose that England once lay under the sea, within the torrid zone. In order to account for these changes, he speculates on an alteration of the earth's axis of rotation, a shifting of the centre of gravity, &c. He accounts for the elevation of the strata of the Alps, Appenines, and Pyrenees, all containing fossil shells, to the effects of earthquakes; and enumerates a list of the most remarkable volcanic eruptions, from the remotest antiquity till his own times. He supposes that the conversion of the bed of the ocean into dry land occurred at the period of the deluge, and that the fossil remains found in these strata may have been deposited during the interval between the creation and the deluge.

Ray, who flourished in 1692, to an acute and philosophical mind, added an intimate knowledge of natural history generally, and a profound reverence and respect for revealed religion. His writings were, at the period, of an extremely popular nature, and his geological creed coincided in general with that of Dr Hooke, for whom he expresses the highest respect. He pointed out the disintegrating effects of the ocean and rivers on the earth's surface, believed implicitly in the scriptural origin of the globe, the recent date of creation, and the assurance of its final dissolution by fire.*

* The "age of Newton" is distinguished for having produced several philosophers, no less remarkable for their profound acumen and learning, than for their firm belief in revelation. We may here be allowed to particularize Grew, the author of *Cosmologia Sacra*—a very curious work—Ray, Hooke, Derham, and "that pure intelligence" Newton himself. Mr Lyell, in noticing Ray's works, makes the following remarks:—"His discourses, like those of Hooke, are highly interesting, as attesting the familiar association in the minds of philosophers in the age of Newton, of questions in physics and divinity. Ray gave an unequivocal proof of the sincerity of his mind by sacrificing his preferment in the church, rather than take an oath against the Covenanters, which he could not reconcile with his conscience. His reputation, moreover, in the scientific world, placed him high above the temptation of courting popularity by pandering to the physico-theological taste of his age. It is, therefore, curious to meet with so many citations from the Christian fathers and prophets in his essays on physical science—to find him in one page proceeding by the strict rules of induction to explain the former changes of the globe; and in the next, gravely entertaining the question whether

Dr Woodward, a physician, also flourished in this period. His practical knowledge of the British strata was considerable; and he made a large collection of fossils, which he arranged systematically, and bequeathed to the University of Cambridge. His geological theories, however, were fanciful, and not at all founded on his practical knowledge. He supposed that the whole strata of the globe were broken down, and reconstructed at the period of the deluge.

Whiston was another cosmogonist of the same school. He attributed the deluge to the contact of a comet with the earth; and was amongst the first who began to tamper with the text of Genesis, and bend its meaning, by means of verbal criticisms, to his own purposes.

Dr Burnet published his Theory of the Earth between 1680 and 1690. He seems to have altogether disregarded practical facts and inductions, and to have given a loose rein to his imagination. His style is glowing and energetic, and his book may be read as a poetic declamation, but it is in all other respects utterly unprofitable. Yet it was highly relished by his contemporaries, passed through several editions, and was a great favourite with Charles II.

the sun and stars, and the whole heavens, shall be annihilated, together with the earth, at the era of the grand conflagration."—*Elements of Geol.* vol. i. pp. 57, 8.

About the beginning of the eighteenth century, geological theories and facts were still farther prosecuted by Vallisneri Lazzaro Moro, and his eloquent commentator, Generelli. The latter describes the waste of the surface of the earth continually taking place, and concludes that this loss and decay must be compensated by elevating volcanic forces.

On a review of the writings of the early geologists, then, it appears, that amid much that is fanciful, and amid many erroneous deductions, drawn from scanty or misconceived facts, still the germs, and, in some instances, the complete development of modern theories are distinctly to be traced.*

* For a full historical view of the early geologists, the reader is referred to Mr Conybeare's Introduction to the Geology of England and Wales, and to Mr Lyell's Elements, vol. i.

SECTION II.

LATER GEOLOGICAL THEORIES.

In 1749, Buffon published his System of Natural History, the preliminary part of which is devoted to a theory of the formation of the earth. Though an eloquent and highly popular author, his cosmogony can lay no high claims to originality of conception, nor was it based on any comprehensive knowledge of the facts even of his predecessors. In general, he adopts the theory of Leibnitz. His supposition that the earth was a portion of the sun, struck off in a fused mass by the stroke of a comet, has been pronounced, by competent astronomers, as inconsistent with the known laws of projectiles; for if such a mass had been thus struck off from an attracting centre, it would again have returned into the sun, after a brief journey in space. His ideas regarding the permanent horizontality of the fossiliferous strata since the period of their formation, are inconsistent with facts; and the only valuable part of his geology, in a practical view, is his

account of the physical changes taking place on the earth's surface.

In 1757, Gesner, the naturalist of Zurich, published a work on fossil remains, with an account of the changes on the earth's surface which they elucidate. And a few years afterwards, a treatise appeared in the Philosophical Transactions, by Professor Mitchell of Cambridge, illustrative of the effects of earthquakes in elevating and producing disturbances on the various contiguous strata, and especially applied these principles to the older formations of Yorkshire.

Geological phenomena were farther elucidated about this period by the travels of Targioni in Tuscany, of Pallas in Russia, — who particularly mentions the fossil skeleton of a rhinoceros, and other bones found in Siberia, — and of Saussure, who made many valuable remarks on the structure of the Alps.

WERNER. — This celebrated mineralogist and geologist was appointed professor of the school of Mines at Freyburg, in Saxony, in the year 1775. He was a man of varied information, of lively fancy, eloquent and enthusiastic, and had the rare talent of gaining over his pupils to an implicit and exclusive belief in his system. He had never travelled, but drew his conclusions from the partial strata in his immediate neighbourhood, and but too hastily

concluded that these represented the whole of the earth's surface. The leading points of his geology may be expressed in a few words. He supposed the earth was originally completely surrounded with an ocean or primordeal fluid, which held in chemical solution the whole materials of the subsequent strata of the globe. That these materials were precipitated at successive epochs, beginning with the lowest primary rocks, which were deposited before the existence of plants or animals, and ascending gradually to the newest formations, which were successively furnished with their peculiar organic remains. He supposed that the earth had suffered several convulsions, or rather inundations of the oceanic fluid, and at a particular period had undergone a great change in passing from its inorganic to its organized condition. This he termed the transition period, indicated by the peculiar grey-wacke rocks, which still retain this general denomination. He allowed of no igneous action except in modern volcanoes, the existence of which he could not well get quit of. Even the basalts and greenstone rocks were with him crystallizations from a chemical fluid, and entire mountains were looked on, in many cases, as one great central crystal. He believed in epochs of indefinite duration; and his physico-theological followers, such as De Luc and Kirwan, readily had recourse to the elongation of the Mosaical day, in order to render their specula-

tions consistent with the sacred history. The simplicity of this system was well suited to many intellects which are best pleased with the readiest and easiest way of accounting for things; and, accordingly, no theory has had a more complete sway in modern times, and none can better illustrate the effects of preconceived system in blinding the eye to facts that are within every one's vision. It is even said, that within a few miles of the school where these doctrines were promulgated, there are obvious proofs of porphyries, called by Werner primary, sending out veins and dykes through coal strata, and even overlying them in mass.*

HUTTON. — Directly opposed to the dogmas of the school of Freyburg, is the Plutonic theory of Dr Hutton, a native of Edinburgh, who first promulgated his doctrine in 1788.

He was a philosopher of comprehensive intellect, and an acute and patient investigator of facts. Although from the previous section it will be seen, that the outlines of his theory were, in a great degree, sketched by his predecessors, yet he had undoubtedly the merit of extending their facts, and bringing them into the shape of a regular system. The Huttonian theory disclaims all attempts at accounting for the origin of things,

* Lyell, vol. i. p. 87.

either in the inorganic or organized world. It merely professes to explain the changes which are continually occurring on the earth's surface. It supposes that an incessant wearing down of the solid land is taking place, by the combined actions of the elements, and that this debris is forming new strata in the bottom of the ocean. At certain periods these strata are fused by a "central heat," into new crystalline rocks, and again elevated into continents and islands. This process is supposed to have been going on, is now in operation, and may continue for an indefinite and inappreciable period of time; so that we can neither form a conception of the beginning or the end of things. As facts corroborative of this theory, Dr Hutton adduces the veins of the oldest known granitic rocks, which he discovered at Glen Tilt, in Scotland, and subsequently in many other situations, passing into the gneiss and schistose rocks of the primary series lying immediately above them; as well as the analogical examples in the greenstone or trap rocks. Hutton was but slightly acquainted with the fossiliferous strata, containing plants and animals, and his observations do not extend to an explanation of their positions in the various formations. Neither did he embody in his theory the analogies to be derived from modern volcanic eruptions, which Steno and Moro, his contemporaries, had so strongly insisted on. Hutton's views were supposed, and

perhaps, in some degree, justly, to partake of the sceptical opinions so "fashionable" in his day, which called for the "Illustrations of the Huttonian Theory," from his pupil and friend Professor Playfair. This work is written with all the charm of style and acute reasoning which characterized that amiable and learned man, and tended to render more popular the somewhat obscure work of his master. An intellectual warfare of many years was rather fiercely waged between the partisans of the Wernerian and Huttonian theories. Much time, and some talent, were unprofitably lost in the contest, till at last the Wernerians have fairly given in, and the leading *facts*, at least, of the Huttonian theory are now universally established, namely, the igneous origin of granite and trap rocks, and the sedimentary nature of the other deposits.

Meanwhile, practical geology, founded on actual phenomena, was making considerable progress in England, first by the solitary and untutored labours of Mr Smith, and afterwards by the institution of the London Geological Society, which ranked among its members Dr M'Culloch, the able investigator of the primary rocks, and of the trap formations of Scotland, Mr Conybeare, the author of a treatise on English strata, and Messrs Greenough and Webster, Professors Buckland and Sedgwick, Messrs Murchison, Lyell, &c. The volumes of transactions published by this society contain a

mass of valuable practical knowledge, chiefly by the members enumerated. On the Continent, the celebrated Cuvier, and his associate Brongniart were no less assiduous in their energetic investigations.

The discoveries of Cuvier, in the strata of the environs of Paris, formed a new era in the history of organic remains, and are already too well known and incorporated into every work of modern geology, to need any explanation here. Cuvier, indeed, may be said to be the Newton of geology, and had his attention been solely devoted to this science, or rather, could he have had his ever-active existence prolonged beyond the period of humanity, we might have hoped from his acute and comprehensive intellect, joined to his laborious investigation of facts, as complete an elucidation of the phenomena of geology as Newton has bequeathed us of the solar system.

Mr Lyell's system, in its leading features, is identical with that of Hutton. He maintains the same infinitude of operations — the same wearing down of old continents, and the resurgence of new ones. He, however, disclaims the interference of all causes except those that are strictly in operation at present, not even allowing an intensity of power beyond what is daily manifested on the earth's surface. In this way he rejects the paroxysmal fusions and elevations of rocks by the unexplained

"central heat" of Hutton and Playfair, and trusts alone for the elevation of strata to the slow and progressive effects of igneous action, as exemplified in existing volcanoes; and thus accomplishes, in an indefinite time, what the Huttonians became bound to execute by one or two immense convulsions. Thus an infinitude of movements, consisting of a progressive decay and renovation of strata, graduating by imperceptible steps into each other, make continually the circuit of the earth's crust; and to accompany these movements in the inorganic mass, a progressive development and destruction of animal and vegetable life take place coincidently: so that system succeeds system, merging into and embracing each other, like cycle and epicycle, where neither beginning nor end is perceptible. To elucidate these views, Mr Lyell has accumulated a mass of most interesting facts regarding volcanic phenomena, and, adopting the hint of Cuvier,* has personally investigated the newer strata in the volcanic districts, so as to enable him to trace a chain of formations, from the oldest visible systems, up to those which have had their origin in the present times. In the former part of this treatise, we have occasionally ventured to state some objections to the above system, and shall here merely subjoin a few farther hints by way of testing the stability of some of the conclusions which it embraces.

* Preliminary Treatise on Fossil Remains.

It is maintained that we have no traces of a commencement of organic life in the earth's strata.

Gneiss and the primary slates, throughout every region of the globe, contain no marks of organic remains; while, at a well defined point in the grey-wacke system, we begin to perceive animal remains, at first sparingly, and afterwards, as we ascend to the higher strata, these, together with plants, increase in a rapid progression.

Mr Lyell suggests that they have been "burnt out" in the primary strata by the action of igneous rocks; but when we examine the mica and clay slates, the stratification is here so perfect, the layers of deposition are so regular, and the particles of mica, quartz, and felspar, are so distinctly and uninterruptedly preserved in the alternate order of their gradual deposition, that it is impossible to believe that such a complete state of fusion took place in them, as to obliterate all traces of animal or vegetable bodies, had such been interposed between those layers. Such a complete state of fusion as this implies would have completely mingled into one mass those separate layers. The examples adduced of stratified limestone having been converted into saccharine marble at the point of junction with the upheaved granite, while the portions more remote still preserve their original distinct lines of stratification, is, we think, an evidence fatal to the theory which it is intended to

elucidate. The same circumstances we have observed in strata of mica schist. These slates, at the point of contact with the granite below, assumed all the appearance of gneiss, while the distant parts of the same strata were distinctly laminar, and easily separated, so imperfect was their cohesion. The chemical composition of the oldest schists, too, will serve perhaps to throw some light on this subject. As contrasted with the secondary fossiliferous strata, the former are more constant and uniform in their composition than the latter, and especially contain a much smaller proportion of lime and carbon,—the amount of calcareous earth increasing in a rapid proportion from the older to the newer formations. Thus gneiss contains less than one half per cent of lime; clayslate about five per cent; while the carboniferous sandstone and shales, contain twice the quantity of lime and carboniferous matter, and the oolites, Oxford clays, &c. have their major part of a calcareous nature. The proportion of lime in the igneous rocks stands thus,—

Granite contains,	0.37	Parts of lime in 100.
Clinkstone,	2	
Greenstone,	7.29	
Basalt,	9	
Lava of Calabria,	10	

Now, the existence of animal and vegetable bodies seems greatly to influence certain chemical actions in the inorganic world; in particular, by a

process of vital chemistry they accumulate lime and carbon, and by the decay of their bodies these substances are mixed up with the other earths of silex and alumina, so that the carboniferous limestone and sandstone, the lias and oolite beds, the recent clays and vegetable soils, if fused by the operation of intense heat, would most certainly yield a different compound from the gneiss, mica-slates, and clay-slates of the primary non-fossiliferous strata.

There appears a greater uniformity in the older strata, as traced in various regions of the globe, than what we could expect from a succession of systems gradually merging into each other as explained in Mr Lyell's theory. We do not mean to assert that there is that perfect uniformity of strata which some have advanced, yet there are evidently well marked formations that have an extensive range on the earth's surface, which would indicate a much greater uniformity of operations than are maintained in the theory, or than are visibly existing in the present epochs. We may instance here the universality of gneiss and the primary schistose strata—the general distribution of coal measures on the different continents,—all indicating a close similarity of their vegetable remains and their mineral composition. Neither have we distinct repetitions of similar formations, such as an old and new lias or oolite, an old or new cretaceous

formation. Indeed, we suspect it would be difficult to point out any operation at present in action for the manufacture of chalk, or oolite, or magnesian limestone beds.

The successive creations of animals we have already alluded to (p. 42, and note IV.) as an assumption without proof or analogy, and which seems to be out of place in a system which allows of no causes but those at present in action.

But supposing all the premises of the theory to be correct, Mr Lyell ought by this to have shewn us not only successive systems of molluscous animals, but also ancient diluviums containing the skeletons of mammalia of a remote and distinct epoch, with the peculiar plants of the period, the ancient soil, boulders, &c. with a series of newer formations, and more recent plants and terrestrial animals superimposed. Now, nothing of this kind can be shewn. We have no diluvium with animals older than the mastodon; we have no huge boulders in the lower fossiliferous strata, and few indications of soil, with the exception of some drifted masses, with trees adhering, in the Newcastle coal-field, and some roots in the Portland beds, all species allied to the era of the coal measures. If any of the diluviums which now repose on the surface of the earth are of an extreme antiquity, corresponding to the supposed epochs of the older strata, how does it happen that they indicate no such relative antiquity by their

organic remains, or by newer strata, or a succession of other diliviums or soils superimposed upon them?

If the surface of the earth, too, has been the theatre of successive systems, how does it happen that no region hitherto investigated presents that obvious appearance of a much greater relative antiquity than others? So striking appeared these facts to Cuvier, that he pronounced it evident that the present epoch or system of things over the entire globe, could only have had a commencement at a period not exceeding five or six thousand years ago. It is true, we have pointed out to us three periods,* when sedimentary deposits have successively taken place, it is said, at comparatively recent dates in the bed of the ocean; but how is the elevation of these and of the older continents above the level of the sea to be referred to different epochs?

What proofs, for instance, are there that the Highlands of Scotland were raised to their present level above the sea in an epoch long anterior to that of the elevation of the Alps, or the tertiary beds of Europe, and during the prevalence of an entirely different organic system? It is true, we have the negative inference of the absence of many genera and species of animals in the strata of the one, which are present in those of the others; but

* The Eocene, Miocene, and Pliocene. Lyell, vol. iv.

then, on the other hand, we have the fact, that at the time, or respective times, when both these extreme strata became dry land, the present system of organic life, both vegetable and animal, was in operation; for, immediately succeeding the ancient tenants of the strata, we find a new soil stocked with plants and animals of the present era. Now, if the Highlands of Scotland had existed as dry land for millions of years previous to the elevation of the Alps, we ought surely to have seen some proofs of this antiquity, either in the inorganic strata, or in its animal and vegetable inhabitants.

It is not here attempted to be denied that new formations are in the progress of forming, or that new land is occasionally elevated. Such operations undoubtedly have been going on most likely throughout the whole period of the existing system of things.

With regard to the igneous rocks, of whatever description, it seems agreed, on all hands, that they owe their production to similar causes acting successively. Yet there seems to have been something like a progressive modification of these causes in the different effects produced. Thus, granite is a different modification, and a somewhat different compound of the materials constituting trap and volcanic rocks. Thus, too, it would be difficult to point out true lavas of a contemporary age with the oldest granites, and in the older systems granite

greatly predominates over greenstone and volcanic rocks, and is of rare occurrence in the more modern formations. Does this prove a regular recurrence of the same identical operations?

The frequency of metallic veins in the older rocks and their almost total absence in the newer, appears also a fact deserving of consideration.

We have already* considered Mr Lyell's limitation of the igneous eruptions of former periods to the same graduated scale of operations as are visible in modern volcanoes; and have there asserted that it is quite legitimate reasoning to suppose that the same volcanic forces may have had a prodigiously increased impetus and extent at certain periods more than others.

In fact, such gradations are actually shewn in every active volcano: we have periods of repose, periods of moderate action, and sudden and powerful paroxysms. Now, the extension of those phenomena to still greater and more universal convulsions is surely within the bounds of fair deduction. We think that the appearance, too, of the upheaved strata in many extensive districts proves the continuous and almost uninterrupted effects of these internal convulsions. We have, in some situations, at least, several hundred miles of the same strata, elevated by trap rocks, without the slightest indica-

tion of any interval of time succeeding, for if other strata had been deposited in the intervals, they should have been visible.

Mr Lyell, in the first edition of his Elements, does not admit the metallic theory of volcanoes, first broached by Davy. On a first view of this theory, it must have seemed fatal to his hypothesis: for, assuming for a moment its truth, that the production of the igneous rocks is caused by the successive oxidation of the metallic bases, which form the great mass of the globe, it must be evident, that if this process continued to go on for an indefinite period, there would come a time, in the lapse of millions of ages, when this oxidation would descend to the centre of the globe, or, at least, so far that future combinations would not affect the surface; and thus Mr Lyell's progression of restorative operations would come to an end, the earth would remain quiescent till the destroying agents, water and air, had levelled the dry land, then the ocean would cover the whole globe, and ancient chaos would come again.

But, in his third edition, vol. ii. p. 291, he has discovered that there are other agencies which would again reduce the earthy oxides into metallic bases, so that they might act over again and again their volcanic eruptions. For this purpose, he calls in the aid of intense heat, to decompose water, and produce hydrogen, the reducing agent. How the

intense heat is to originate after the oxidation of the elementary metals has been effected, he has not informed us.

"One great objection to the theory of Hutton was his assumption of an internal fire to fuse his stratified masses, when they had accumulated in sufficient quantity to form new continents and islands. The discovery of the metallic bases of the earths, however, seems, in some measure, to supply an explanation of the occurrence of occasional intense heat, without the aid of central fire continually existing, or of materials, combustible in the usual acceptation of the term. Mr Lyell is of opinion that this hypothesis is as gratuitous and arbitrary as the original igneous fluidity of the globe, propounded by Leibnitz. We humbly think, however, that the metallic theory has facts to support its probability, while the other is a pure hypothesis.

NOTES AND ILLUSTRATIONS.

Note I. p. 33.

We subjoin the following remarks on the strata round Edinburgh, from our Geology of the district.

"Another subject of inquiry is the relative age of the trap rocks; and to decide this, we think we have sufficient data. From the entire absence of trap debris in the sandstone of the coal measures, and, on the other hand, from the uniform presence of mica there, we are entitled to conclude that granite or gneiss rocks furnished the materials of this extensive deposit; and that consequently, no trap rocks existed in the vicinity up to the period of the last carboniferous deposit. In the more superficial strata, within a few hundred yards of the surface, we begin to have evidence of trap.

That the trap rocks have been the agents in the elevation of the carboniferous strata, is also evident; for these disrupted strata rest upon the trap; and on the south side of Arthur's Seat, portions of limestone and sandstone still remain, which have been carried upwards.

Another question arises: — Are the trap rocks all of one age, or are they of different epochs? There appear to be two facts which indicate a difference of age of

these rocks: First, The different character of the trap placed in juxtaposition, and the marks of disturbance by which the older was affected by the intrusion of the subsequent; Second, The appearance of trap debris, and rounded masses of these rocks imbedded in strata which have been elevated by a subsequent eruption of trap.

If we might form any conjecture, however, from the quantity of this debris accumulated, the period between the first and last eruption of trap must not have been long — certainly a very short period, indeed, compared to the time necessary for the deposition of the coal strata.

The next inquiry is — Were the trap rocks elevated under the water of the ocean, or after the plain of Mid-Lothian became dry land? The facts stated immediately before, will shew that the first eruption of trap, at least, must have been while the waters of the sea still flowed over the spot, and that the ocean continued to flow for some time, by which the trap debris was formed, and many of the large boulders probably carried to the situations where we now find them.

Another fact corroborative of this is, the amygdaloidal state of the vesicular trap of Arthur's Seat and the Pentlands, which must have been owing to a deposit of matter held in solution by a fluid in which they were immersed, subsequent to their eruption in a porous lava-like form.

That dry land, however, almost immediately succeeded the last elevation of the trap rocks, is apparent from the state of the diluvium which lies immediately above, and which appears to have been at once deposited, before the sharp edges of the rocks had time to be worn down,* and which diluvium has ever since remained undisturbed and unmixed with any marine substances which could indicate the presence of an ocean. To this diluvium has

* This is seen at Niddry quarry, and elsewhere.

succeeded, at no long interval, the present soil, with its present vegetables and animals.

The most remarkable and unaccountable circumstance accompanying the last elevation of the trap, seems to have been a total and abrupt change of the whole country. The animals and vegetables that covered the former soil, and stocked the former seas and rivers, appear to have been entirely destroyed, and their remains overwhelmed and buried in the great convulsion of nature. Not only had their destruction and extirpation been complete, but the whole constitution of soil and climate seems to have been so altered, as to preclude the possibility of their again existing, had a remnant even been saved. From all we can ascertain of the structure, both of the animals and vegetables of this early period, they bear a nearer analogy to those of tropical climates than to any that exist in the temperate regions of the globe.

We here in vain look for any thing intermediate between the animals and vegetables of the carboniferous era and those of the present. The same kind of coprolites are found in the alluvial clay as in the low-lying shale; and in the highest beds of the coal measures, the same leaves snd trunks of vegetables are in as great abundance as in the seams 3000 feet lower.

Immediately, too, after this convulsion, the sedimentary deposit of sandstone appears to have ceased. No more vegetable remains, either, have been accumulated in those singularly alternate layers which seemed to mark a periodical overflow of some huge river, or some other unknown modification of transporting currents. Not only had the catastrophe produced a local change, but it had extended to all the region then in connection with this part of the country.

In the alluvium, we have already remarked that many rounded masses or boulder stones are to be found. These consist of fragments of all the rocks in the neigh-

bourhood, together with some of granite, gneiss, and porphyry, that must have been transported from a distance of not less than fifty miles. The position of these stones, relatively to the masses from which many of them have evidently proceeded, indicates decidedly a current flowing with considerable force from west to east. Masses of sand, too, accumulated in various places, exhibit that waved stratification which evidently proves the existence of a former current. In the diluvium around Edinburgh, few or no traces of the remains of mammalia have been found; but to the westward, about Alloa, and in Stirlingshire, the ivory tusks of the elephant, and the horns of ruminating quadrupeds allied to the elk, have been from time to time discovered. All these circumstances, joined to the appearances already pointed out at Burdiehouse, lead to the conclusion that land has existed to the westward, that from thence has proceeded one or more large rivers, and that the situation where Edinburgh now stands may have been the bottom of some estuary."

Niddry quarry is about two miles south-east of Edinburgh, and is formed by the tilting up of the northern edge of the Mid-Lothian coal measures, by means of the greenstone rocks, which intersect these deposits. The strata, as seen in this section, are nearly vertical, and consist of alternate layers of shale, sandstone, and seams of coal.

Immediately above the strata thus elevated, is superimposed the diluvium *c*, *c*, a mass of clay, five feet in depth, with fragments of sandstone and boulders, of the same nature as those which prevail in the surrounding district. The sharp unworn edges of the sandstone and shale, exhibiting the same appearance which they must have borne when newly severed from the connecting layers, proves that the superposition of the diluvial matter immediately succeeded this elevation; and the

a, *a*, Sandstone. *b*, Shale. *c*, Diluvium with boulders. *d*, Present soil.

mass of diluvial matter which penetrates about two feet into the fissure at *e*, evidently shews that no denuding current had swept away any newer strata which might have been deposited above; for such newer strata, if it had existed, must have pre-occupied this fissure.

In this same diluvial covering, at Clifton Hall, near Falkirk, fifteen feet below the surface were discovered some years ago, two tusks of a fossil elephant,* and several other fragmentary remains of mammalia are occasionally, though rarely, met with. Now, the question is, Was the elephant a contemporary of the diluvial clay in which its tusks were imbedded? and was this diluvium contemporaneous with the coal measures above which it lies? If these questions are admitted in the affirmative, then we have the fossil elephant a contemporary of the coal formations. But we have the megalichthes, and many other species of extinct fishes and shell mollusks, in the coal and subjacent limestone, which would also, in this way, claim a contemporary era with the mammoth.

* Mr Bald. Wernerian Transactions, vol. iv.

Note II. p. 37.

"Within the last ten years, three large trees have been found in Craigleith quarry, near Edinburgh, which have excited great attention, and have been minutely investigated. In 1826, a tree was exposed, measuring thirty-six feet in length, and three feet diameter at the base; and, in November 1830, one still more remarkable was displayed to view. This tree was found about the centre of the quarry, at a depth from the surface of about one hundred feet. A considerable portion of the top was broken off and destroyed when first discovered; but more care having been observed afterwards, the whole was exposed in such a manner, that its form and size and position, could be well ascertained.

The entire length of this tree was forty-seven feet, exclusive of the top, which was broken off, and supposed to be about twelve feet. Its breadth varied from two to one and a half feet. Its greatest diameter, near the base,

was, in one direction, five feet. It was of a compact solid structure, its original shape apparently well preserved, with the exception of part being somewhat flattened, probably by the unequal pressure caused by one portion becoming consolidated before another, and thus the softer parts giving way. The external surface was incrusted with coaly matter, varying from a quarter to half an inch in thickness, which was evidently the outer portions and bark converted into bitumen. The tree lay in a slanting direction, with its lower end dipping to the south-east. It lay across several strata of sandstone and shale, the upper beds of which rested in an unconformable position on the lower — the latter forming a sort of hollow trough. There were no traces of either branches, leaves, or roots, attached to this fossil; both its upper and lower ends were evidently rounded, and worn smooth by attrition. About a third from the top, it was bent and somewhat flattened; distinct elevations were seen at intervals on the trunk, corresponding to the places where branches may be supposed to have grown.

A branch was discovered a little to the south of the position of this tree in the same year; and, in 1833, another large trunk was exposed in a deeper part of the quarry, about fifty yards to the westward.

This tree lies at an angle of forty-five degrees, and rests on strata, dipping to the east by north. Upwards of thirty feet have been already exposed; the greatest diameter is about three feet; irregular swellings or rings are distinctly visible on the trunk, and two distinct hollows where branches have grown out."—*Geology of the Environs of Edinburgh*, p. 52.

When the first fossil tree was discovered in Craigleith quarry, near Edinburgh, various conjectures were formed regarding the class of plants to which it belonged. According to the canons of Brongniart, then in full force, its position in the lower fossiliferous beds ranked it among the arborescent ferns: then, when its structure clearly indicated that it was a tree, a new specific name was given to it, and it was henceforth pronounced an extinct fossil. It might, in this way, according to the prevailing theories, have been for ever, to use an expression of Swift, "kicked out of creation," had not Mr Nicol, after much labour and patient induction, and aided by the lucky chance of receiving a spar of New Holland pine which had been brought to Leith spliced to the mast of a vessel, detected its exact conformity with a recent species. Thus this splendid fossil, instead of obtaining a niche in the archives of a pre-existing world, was found to be identical with a species of araucaria, at present flourishing in the islands of the South Sea.

Note III. p. 39.

THEORIES OF IGNEOUS ROCKS.

All those speculations regarding the primary condition of matter, and the original formation of the sphere of the earth, are of a very unprofitable nature, in so far as the phenomena attending them cannot be compared to any operations at present in action. It is evident that we now see matter only as it has undergone various chemical combinations and changes, and under forms and obeying laws totally different from its original condition. The oblate spheroidal figure of the earth has been thought to imply a state of fluidity of the whole mass: yet there are no valid grounds for assuming this; for the matter of the globe may just as readily be supposed to have been formed into this particular figure, to suit subsequent laws of rotatory motion, before even the law of fluidity was imposed upon it. Neither are we at all certain whether the globe be a solid sphere of matter with a density increasing towards the centre, or a hollow ball. The experiments of Maskelyne and Playfair, if accurate, would rather indicate the former condition, proving its mean density to be five times that of water. On the other hand, the existence of a highly elastic medium occupying the centre, is not an improbable supposition, and perhaps more in accordance with the economic analogies of nature; for in none other of her works do we witness that prodigal waste (if the term may be allowed) which such an enormous mass of matter, apparently for no immediate use, would indicate. The well known *luminous* theory of the late Sir John Leslie may thus turn out, after all, a most brilliant idea.

The existence of the different earths which compose the principal mass of the crust of the globe in a metallic state, as shewn by the splendid discoveries of Davy, and

the farther application of these to the origin of volcanic phenomena, as prosecuted by that distinguished philosopher, and by Dr Daubeny, are theories now very generally adopted by geologists. These theories certainly account for the production of all the varieties of igneous rocks in a much more satisfactory way than any other; yet we must by no means conclude, that the discovery of the metallic basis of the earths has brought us to the ultimate elements of things. We know so little of matter, that it may be perfectly possible that it consists of only one simple element, or, to take the Platonic doctrine, two, and that all its varied aspects may be due to the various laws imposed upon it....

If we view the elevation of igneous rocks, then, as portions protruded from the matter of the earth's crust by chemical actions, the magnitude of these, compared to the mass of the earth's diameter, dwindles into mere insignificance, and need not demand any lengthened eras for their production. See Section, Plate IV.

NOTE IV. p. 42.

SUCCESSIVE CREATIONS OF ANIMALS.

"When I endeavour to prove that the rocky strata contain the skeletons of several genera, and the loose strata those of several species, all of which have ceased to be existing animals, I do not pretend that a new creation was required for calling our present races of animals into existence. I only urge that they did not anciently occupy the same places, and that they must have come from some other part of the globe."*

It is somewhat extraordinary that those theorists who profess to draw their deductions exclusively from causes now in operation, should yet so unceremoniously

* Cuvier, Recherches sur les Ossmens Fossiles, tom. i. 1821.

advance the proposition of a successive production of new species, when there is evidently no such law or fact to be found in nature. The idea of spontaneous production has long ago been scouted from science, and the no less illogical one of equivocal generation is fast going. We see no analogy in nature to lead us to suppose that such a law exists — we see no provision for such operations, and no trace of such having ever occurred — we can predicate that the earth will produce certain plants after we have deposited certain seeds, but that if such seeds are carefully excluded, that no species of vegetation will follow — we can predicate that a lupin seed will produce a certain flower, followed by a seed similar to the parent one; and we may speculate freely on certain varieties of these, which circumstances may modify the production of, but we know to a certainty, from experience and analogy, that the lupin can never produce a rose, and that the soil alone will never bring forth a new species of plant.

It is fair to presume, then, that as the origination of species is unknown in nature, it does not exist. It is asserted that it does exist, but that the periods of its operation are at immensely distant intervals. This is a mere assertion, without proof by facts, and is contradicted by analogy; for the periods of germination and animal reproduction are all within limited cycles, depending on circumstances, which occur periodically, and which are apparent as contrivances in nature. The "recent introduction of man on the globe" has been given as an example of repeated acts of creation. But this is merely assuming as a fact a conjecture, of which we have no conclusive proof.

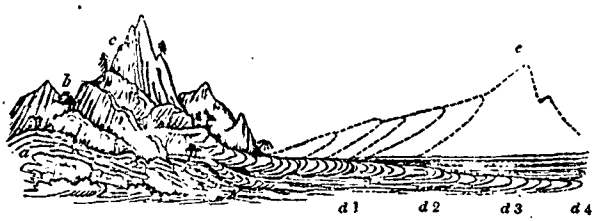
A reasoner of another school may say, that as organized beings were created at first, new species may be afterwards added by a special repeated act of the Creator. It may be answered, that we are told that organized beings were at first made by the Creator, but

we have no information of subsequent operations of a similar kind; and having no good grounds to prove it, the assumption of such after acts is illogical. For, suppose we were to assume the reverse proposition, — that the creation of organic beings was an act that was accomplished at once, under peculiar circumstances, and which it was impossible to repeat, this is just as tenable and irrefragable an argument as the other. It is astonishing on what flimsy grounds even such a mind as that of Blumenbach could speculate on this subject. Because the animalcule, called the *vibrio aceti*, is found only in stale vinegar, a substance produced by civilized man, this philosopher argues, that this being must have been of recent creation or origin. Yet a moment's reflection might have convinced this acute naturalist, that similar products to vinegar exist in nature, and must have existed from the beginning — as in sour grapes, a decaying sugar-cane, and every other vegetable with fermenting saccharine juices. We have entered more at large into this subject in a paper in the Edinburgh Journal of Natural and Geographical Science, vol. II. 1830.*

Linnæus conjectured that plants and animals originally radiated from a common centre in the tropical zone of the primitive earth, where the altitude of mountains produced that variety of climate suited to their different natures, and that thus a gradual diffusion took place over the whole earth.

A modification of some theory of this kind might be employed to explain the appearances of our fossiliferous strata, in opposition to that of successive creations, and may be thus exhibited in the following diagram :—

* We beg to state, that both here and in the text, we do not attempt to prove that successive creations of organized beings *may not have taken place*, but that hitherto we have no direct proofs of such.



a, Torrid zone—region of palms, &c.
b, Temperate zone—region of grain, grasses, oaks, &c.
c, Frigid zone—region of pines, heaths, mosses, &c.
} Forming the ancient continents, now partially or entirely submerged.

d 1, *d* 2, *d* 3, *d* 4, Detrital matter formed in ancient seas, with animals and vegetables emanating from primary centre.

e, New continents subsequently elevated, forming the present land.

The successive circles, *d*, *d*, *d*, *d*, may indicate the several formations; *d* 4 being the first deposit in the depths of the ocean, and containing the remains of animals that formed the pioneers of the yet untenanted spaces around; *d* 3, *d* 2, *d* 1, representing the next orders in succession. To fill up this hypothetical sketch, we must suppose other centres formed contemporaneously, but under different modifications; and that repeated elevations of the marine strata took place, by which the ocean level, and other circumstances, were so altered as to interrupt the farther increase of the same species in the same localities, while at the period or periods when this ocean bed finally became dry land, the temperature was so changed as to admit of a more complete separation of genera and species, and their more varied dispersion over the globe.

Note V. p. 48.

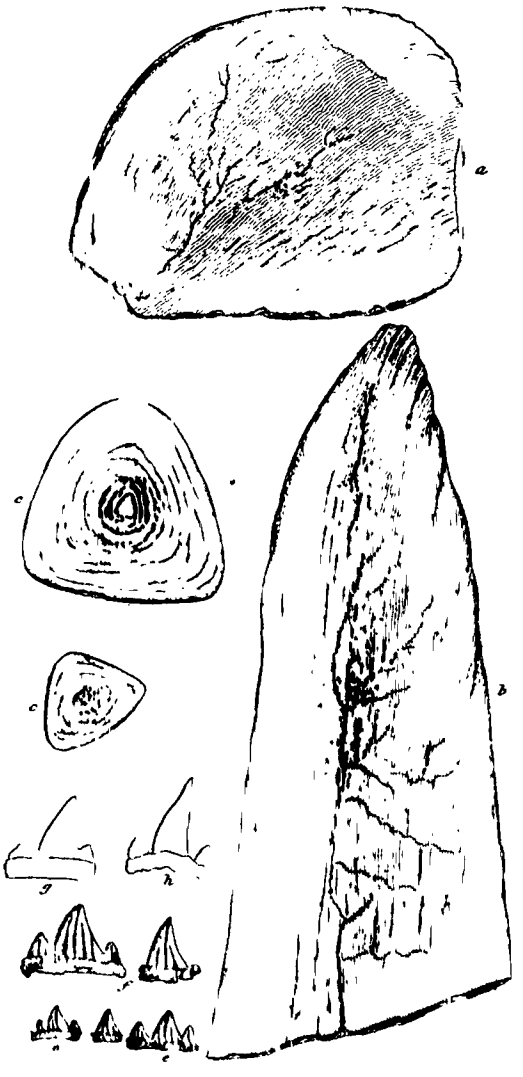
The Burdiehouse limestone is an evident fresh water formation, situated below the Edinburgh coal-field, and belongs to the carboniferous limestone strata contiguous, forming a partial and local deposit. Besides the ichthyological remains discovered and described by Dr Hibbert, (Edinburgh Philosophical Transactions, vol. xiii.) and enumerated in my Geological Sketch of the Environs of Edinburgh, I have since found several fragments of bones, which appear to me to belong to animals of a higher class than fishes, and probably to the class reptilia. One bone, five inches in length and four in breadth, has much the appearance of a coracoid bone of some unknown reptile.

The bones figured in the annexed plate are of the natural size, from a slab of the same limestone; the bone *a* is exactly the shape of the larger specimen in my possession. There are two similar ones in the same piece of limestone, and two the same as *b*. Both these latter are imperfect, but the fragments have a resemblance to scapular bones.

These bones differ from those of fishes in having a more compact structure, and a less fibrous appearance, in having well defined edges and furrows, marking out the situation of blood-vessels traversing their surface. The bodies *c c* are of frequent occurrence in this locality. They differ from the scales of the ganoid order of fishes, also abundantly found, resemble somewhat the scales of the cycloid order, but *may* be the dermal scales of some reptile.

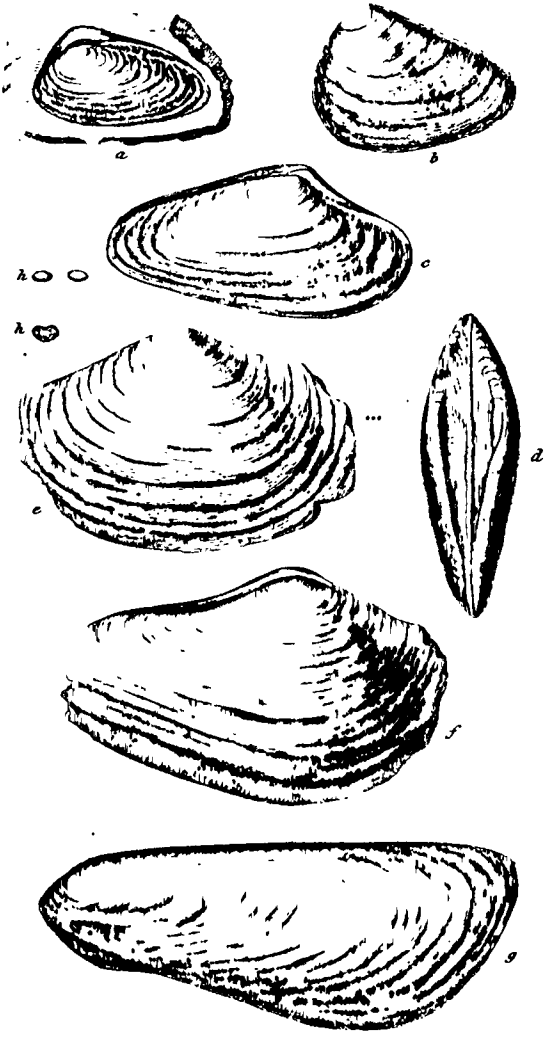
I have also found two portions of jaw bones, with numerous small teeth, which are figured *e, e*, somewhat magnified; *f* are the same still more magnified, and evidently resemble the teeth of a shark. These teeth are very numerous in the jaws, indicating the double and

PLATE I.



W. Phor. sc.

PLATE II.



W. Rhind del.

Jones sc.

treble rows peculiar to the shark; but the animal must have been of a small species, or more probably a young one. The tooth *g* is figured from Agassiz, (*Carcharias Megalotis,*) and figure *h*, from a drawing by Dr Mantel, of the *squalus mustelus*, in the Wealden beds of Sussex.

At Woodhall, on the north side of the Pentland Hills, the coal strata are exposed on the banks of the Water of Leith. In a stratum of shale, lying below ten feet of sandstone, an immense number of the bivalve shell, plate 2, figs. *a* and *b*, are visible. The only figures of shells in the least resembling these, which I have seen, are in Cuvier and Brongniart's Illustrations of the Paris Basin, (Ossmen. Fossil. tom. ii.) supposed *Cytherea convexa;* and in vol. iv. pl. 314. of Sowerby's Fossil Conchology, under the name of *Axinus obscurus*, said to be found in magnesian limestone. Both species differ from the figure here given, which may be named, from its locality, *Axinus Pentlandicus.*

Figures *c, d, e, f,* are unios from the coal shale at Polmont, near Falkirk; *c* appears almost identical with Sowerby and Mantel's *Unio antiquus* of the Wealden.

Figure *d* is the same shell shewing the hinge.

Fig. *f.* resembles the *Unio compressus* of the same locality.

Figures *h h* are minute shells, found in great numbers in the Burdiehouse limestone, supposed to be of the genus *Cypris.* Species of these are abundant in the Sussex beds.

Figure *g* is evidently a modiola, found in the same beds with *Axinus Pentlandicus,* at Woodhall, and differs little from the existing species.

Sphenopteres and *equisitæ* are also abundant in this shale. The *Sphenopteris affinis* found in Burdiehouse seems analogous to the *S. Sillimanni* of the Wealden beds, figured in Dr Mantel's work.

NOTE V.* p. 52.

LIST OF GENERA OF FOSSIL MAMMALIA HITHERTO DISCOVERED.

ORDER I.	BIMANA,	No well authenticated fossil remains of man have been discovered.
II.	QUADRUMANA,	Jaw-bone of a monkey found in cave in Department of Gers, in France.
III.	CARNIVORA,	Bat, pterodactyle—*Europe*. Agnothorium, size of lion, dog, fox, wolf, cat—*Europe and India*. Hyena, Viverra.—*Europe*. Ursus spoleus, U. arctoides, machairodus—*Europe*. Phoca, 2 sp.—*Europe*. Opossum—*Europe*, *N. Holland*.
IV.	RODENTIA,	Mus, squirrel, dormouse, beaver, 2 sp. hare.—*Europe*.
V.	EDENTATA,	Megatherium, megalonix, gulo.—*S. America*.
VI.	PACHYDERMATA,	Tetracaulodon, allied to mastodon. Mammoth, 2 sp.—*Europe*. Mastodon, 5 sp. *America*, *Europe*. Rhinoceros, 4 sp.—*Europe*. Hippopotamus, 2 sp.—*Europe*, *India*. Lophiodon, 15 sp. allied to tapir and hippopotamus. Tapir, 2 sp.—*Europe*. Paleotherium, 12 sp. allied to tapir—*Europe*. Anthracotherium, 7 sp. allied to hog and hippopotamus. Cheropotamus, allied to hog, babyrousse—*Europe*. Elasmotherium. Chalicotherium, 2 sp.—*Europe*. Adapis, allied to hedgehog—*Europe*. Equus caballus—*Europe*, *America*. Hippotherium, allied to horse. Sivatherium, intermediate between pachydermata and ruminantia—*India*.
VII.	RUMINANTIA,	Anoplotherium, 5 sp. *Europe*, *India*. Cervus, 7 sp.—*Ireland*, *Germany*, *France*. Bos, urus, musk, ox—*Europe*, *America*. Camel—*India*.
VIII.	CETACEA,	Whales in alluvium. Dinotherium, either belonging to this order or to the pachydermata—*Europe*.

The above list contains the whole genera of fossil animals yet discovered; and the number of species may amount to about seventy. It will be observed, that the greater proportion of species belong to the order *Pachydermata*, or thick-skinned animals, and consist chiefly of those that are aquatic, or that frequent the banks of rivers. Now, when we consider the nature of the strata of which our present continents are formed, consisting almost exclusively of marine and fluviatile deposits, this is just the sort of terrestrial animals that we might expect to find enveloped in these strata.

In this list, species of the Hippopotamus, horse, beaver, weasel, hare, dog, fox, ox, deer, camel, have been found so nearly resembling living species, as to warrant their being pronounced identical, while others differ only in a slight degree from existing species.

The geographical localities of these fossil remains are here given, which point out a distribution in many cases different from that which prevails at present.

Note VI. p. 59.

FORMER TEMPERATURE OF THE EARTH.

After alluding to the theories of central heat and increased volcanic action in former ages, Sir J. Herschel observes, — "Neither of these can be regarded as real causes in the sense here intended; for we do not know that the globe has so cooled from fusion, nor are we *sure* that such supposed superior activity of former than of present volcanoes really did exist. A cause possessing the essential requisites of a *vera causa* has, however, been brought forward by Mr Lyell, in the varying influence of the distribution of land and sea over the surface of the globe; a change of such distribution in the lapse of ages, by the degradation of the old continents and the elevation of new, being a demonstrated fact, and the

influence of such a change on the climates of particular regions, if not of the whole globe, being a perfectly fair conclusion, from what we know of continental, insular, and oceanic climates, by actual observation. Here, then, we have a cause, at least, on which a philosopher may consent to reason: though whether the changes actually going on are such as to warrant the whole extent of the conclusion, or are even taking place in the right direction, may be considered as undecided till the matter has been more thoroughly examined."—*Discourse on the Study of Natural Philosophy.*

The distribution of heat on the surface of the globe, and the modifications of climate as influenced by the excess or deficiency of land, is a subject full of interest, and has been beautifully illustrated by Humboldt, in his remarks on Isothermal lines. (For a summary of his treatise see Edinburgh Philosophical Journal, vol. iii. 1820.) Without a knowledge of this subject, the true import of Mr Lyell's theory of change of temperature cannot be sufficiently appreciated.

Note VII. p. 61.

Those geologists who believe in the existence of a previous world reckon all the strata below the superficial diluvium as belonging to this ancient state of things, and that the creation of the present earth and present system of things commences with the soil and vegetation above this diluvium, the effects of the deluge being supposed to have been of a slight and transient nature, and to have left no proofs behind. Professors Buckland and Sedgewick, the Rev. Mr Conybeare, and many others, avow this opinion.

Cuvier believed the present system of things to have commenced immediately after the deluge, when the present surface was elevated above the level of the ocean.

A third party ascribe no definite period to the com-

mencement of the present system, but allow that man was introduced upon the earth at the period indicated by historical record. Hutton, Playfair, and Lyell, adopt this opinion.

Note VIII. p. 64.

The effect of rivers wearing down their channels we have remarked in several of the waterfalls in Scotland, particularly at the Cauldron Linn, or waterfall on the Devon, in Clackmannanshire, where there is a sinking of the fall of ten feet through a chasm worn in the hard greenstone rocks. The gradual progressing of the fall of the mighty Niagara upwards to its source in lake Erie, is also well exhibited in the frontispiece to Bakewell's Elements of Geology, 4th edition. From this sketch it appears that the river Niagara, which flows out of lake Erie, has, in the course of ages formed a deep channel, of seven miles in length, from the present falls to Queenstoun, and that the cataract has, in all probability, been situated at this lower point when it first began to flow, but that it is now progressively wearing upwards. Mr Fairholm has also some interesting calculations on the probable time which has been necessary for the river to excavate this course.

Note IX. p. 75.

FABER'S EXPLANATION OF THE MOSAIC DAYS.

" The divine Sabbath, instead of being limited to a single natural day, is, in truth, a period commensurate with the duration of the created universe. What that duration will be, no one knows, save the Father only, (Mat. xxiv. 36;) but this we know, that according to the

Hebrew chronology, the world has already existed nearly six thousand years, and that according to the Samaritan chronology, it has existed longer than six thousand years. The divine Sabbath, therefore, is a period of not less duration than six millenaries. But an analogy of language requires us to interpret homogeneously the seven days which constitute the great week of God. Hence, as the seventh day is a period of not less duration than six millenaries, each of the six days must, similarly and proportionately, have been equivalent to a period equalling or exceeding six thousand years. Of this great work, our minor week is a commensurative epitome. Our six days of labour correspond to the six periods of God's labour, and our sabbatical day shadows out the sabbatical period during which the Almighty has rested from all his work which he had made.'

"The first day, or first six thousand years, was engaged in the separation of light from darkness, and of the elements of fire from the crude aqueous matter which constituted the primeval chaos. The second day, or second six thousand years, was employed in disengaging the elements of air from the same discordant mass, when a separation of the waters immediately and necessarily took place. The third day, or third six thousand years, was employed in the separation of the lower water from the element of earth, and in the production of vegetables. The fourth day, or fourth six thousand years, was engaged in forming and placing in the material heavens the sun, and moon, and stars. The fifth day, or fifth six thousand years, was engaged in a twofold work—in the earlier part, the waters brought forth fishes; during the latter part, they produced birds. Several great mundane revolutions must have taken place ere the commencement of the sixth day, and, therefore, in the course of the third, and fourth, and fifth days. The sixth day, or sixth six thousand years, was employed in the formation, first of beasts and reptiles, and lastly of man. The seventh day, or actual series of six thousand years, more

or less, gives the analogical rule or measure of each of the preceding."—FABER *on the Three Dispensations.*

Is it not singular to think that an acute and able mind should waste its efforts in such purely fanciful speculations?

DR CHALMERS' OPINION.

Dr Chalmers was so kind as to direct my attention to a review of Cuvier's Theory of the Earth, which appeared in the Christian Instructor for April, 1814, from which I have here taken the liberty of inserting several extracts, as containing the opinion of this celebrated divine on the authenticity of the Mosaic narrative.

"The strength of the Christian argument has never been brought fairly into contest with the speculations of geology. These speculations are almost entirely constructed upon presently existing appearances; for they are but very slightly modified by the very slender materials which have come down to us in the records of past times. Let us suppose that a very ancient record of geological facts were discovered, with the most conclusive marks of authenticity upon it, and that it gave the lie to the most popular and accepted theory of the day. The circumstance of that theory, being the most probable of all those which had been started upon the facts within our reach, would not be suffered for a moment to exclude the new information which had broke in upon us. It were a sad transgression upon the inductive philosophy to refuse this information, with not another reason to set it aside, than that it is inconsistent with our theory. The information must be received, if it has enough of its own appropriate evidence to make it credible, — even the evidence of history. A man of true philosophical habits would be thankful for it, and if a theory must be got up, he would accommodate it to the wider field of induction which lay before him.

"Now, it is not necessary that the author of the record in question be a naturalist by profession. Julius Cæsar may have chosen to give us the height of the cliffs at Dover, and have gratified our present geologists by giving them to understad that the actual degradation of these precipices is as rapid or as slow as they have conceived it; or he may have puzzled them with a piece of information totally unlooked for upon this subject, and sent them a seeking after consistency to their speculations about the alteration of level in the sea, or the inequalities of that expansive and elevating power, which they fancy to be at work under the surface of the globe.

"Moses is not a naturalist by profession; but, in the course of his narrative, he brings forward facts which may confirm or may falsify the speculations of naturalists. Strange mixture of credulity and scepticism! that the slender plausibilities of theory should have such influence upon the one, while the competency of Moses, as a historian, should make no impression upon the other. If these two principles existed in different minds, it would fail to astonish us. But that there should be room in the same mind for so much facility of conviction on the one hand, and such an obstinate resistance to evidence on the other, is just one of those perversities of infidelity, which serve both to illustrate the history, and to lay open the principle, of its melancholy delusions.

"Nor is it necessary to assert, in positive terms, the competency of Moses as an historian. It is enough to bring it forward as a point, which must be disposed of before geologists can have free room to expatiate upon that field of inquiry on which they have ventured themselves. If, by the labour of a sound and patient criticism, they can succeed in deposing the Jewish legislator from a place among the accredited historians of other days, every lover of truth will thank them for the new light they have thrown on this very interesting question. But till this be accomplished, the testimony of Moses remains a drawback to all their theories; and it is just

as unphilosophical to withhold their attention from his narrative, as it would be for theorists in chemistry to refuse a hearing to him who offers to arrest the progress of their speculations by the narrative of his actual experiments.

"The credibility of Moses as an historian is the right weapon for defending the integrity of our faith against the inroads of geological speculation. The tone of truth, and the consistency which pervade his narrative; the solemn reverence for the God of truth, which animates the whole of it; its uncontrolled credit with the Jewish people in spite of all its severities against them; the likely origin which it assigns to institutions kept up by the nation to the latest period of their history, and which no artifice could have introduced at an age subsequent to that of the historian himself; the united testimony of Jews and Christians, that best guarantee for the integrity of the copies since the days of our Saviour; and, above all, the express testimony of our Saviour himself, bringing the whole authority of his religion, with the full weight of its wonderful and unexampled evidences, to the support of the Mosaic narrative, — these, these, are the mighty bulwarks which stand in secure defiance against the visions of geology, and out of which we may cast a fearless eye over the mustering hostility of its aërial and ever-shifting speculations.

"It is not our object to come forward with a full analysis of the theory of Cuvier. The appearance of the work has afforded matter of triumph and satisfaction to the friends of revelation, though, in these feelings, we cannot altogether sympathize with them. It is true that his theory approximates to the information of the book of Genesis more nearly than those of many of his predecessors; and the occasional exhibitions of infidelity which appear in the course of his pages, have the effect at least of stamping the character of a disinterested testimony upon his opinions. This leads us to anticipate the period when there will be a still closer coincidence

between the theories of geologists and the Mosaical history of the creation. It is well that there is now a progress to this object; that the chronology at least of Moses begins to be more respected; that a date so recent is ascribed to the last great catastrophe of the globe as to make it fall more closely upon the deluge of the book of Genesis; and when we recollect the eloquence, and the plausibility, and the imposing confidence with which a theorist of the day has magnified the antiquity of the present system, we shall henceforth be less alarmed at any thing in the speculations, either of Cuvier or of others, which may appear to bear hard upon the credit of the sacred historian."

After a concise statement of Cuvier's theory, he thus proceeds, — "A man may be a good geologist, and be able to construct as good a system as the mineralogical appearances around him enable him to do. But this system is neither more nor less than the announcement of past facts, and geology forms only one of the channels by which we may reach them. But there are other channels, and the most direct and obvious of them all to the knowledge of the past is the channel of history. The recorded testimony of those who were present or nearer than ourselves to the facts in question, we hold to be a likelier path to the information we are in quest of, than the inferences of a distant posterity upon the geological phenomena around them, just as an actual history of the legislation of old governments is a trustier document than an ingenious speculation on the progress and the principles of human society. You protest against the knife and demonstrations of the anatomist as instruments of no authority in your department. We protest against the hammer of the mineralogist and the reveries of the geologian, as instruments of no authority in ours. You think that Cuvier is very slender in geology, and that he has been most unphilosophically rash in leaving his own province, and carrying his confident imaginations into a totally different field of inquiry. We cannot

say, that you are very slender in the philosophy of history and historical evidences, for it is a ground you scarcely ever deign to touch upon. But surely it is a distinct subject of inquiry. It has its own principles, and its own probabilities. You must pronounce upon the testimony of Moses on appropriate evidence. It is the testimony of a witness nearer than yourselves to the events in question; and if it be a sound testimony, it carries along with it the testimony of a Being who was something more than an actual spectator of the creation. He was both spectator and agent. And yet all that mighty train of evidence which goes to sustain the revealed history of God's administrations in the world, is by you overlooked and forgotten; and while you so readily lift the cry against the unphilosophical encroachment of foreign principles into your department, you make no conscience of elbowing your own principles into a field which does not belong to them.

"But it is high time to confront the theory of our geologist with the sacred history — with a view both to lay down the points of accordancy, and to show in how far we are compelled to modify the speculation, or to disown it altogether. . . . . .

"But, generally speaking, geologists are not guilty of disowning the act of creation. It is in theorizing on the manner of the act, (and that, too, in the face of testimony which they do not attempt to dispose of,) that they make the most glaring deviation from the spirit and principles of the inductive philosophy. We have no experience in the formation of worlds. Set aside revelation, and we cannot say whether the act of creation is an instantaneous act, or a succession of acts; and no man can tell whether God made this earth and these heavens in a moment of time, or in a week, or in a thousand years, more than he can tell whether the men of Jupiter, if there be any such, live ten years or ten centuries. Both questions lie out of the field of observation; and it is delightful to think, that the very principle

which constitutes the main strength of the atheistical argument, goes to demolish all those presumptuous speculations in which the enemies of the Bible attempt to do away the authority of the sacred historian. 'The universe,' says Hume, 'is a *singular* effect;' and we, therefore, can never know if it proceeded from the hand of an intelligent Creator. But if the Creator takes another method of making us know, the very singularity of the effect is the reason why we should be silent when he speaks to us; and why we, in all the humility of conscious ignorance, should yield our entire submission to the information he lays before us. Surely, if without a revelation, the singularity of the effect leaves us ignorant of the nature of the cause, it leaves us equally ignorant of the *modus operandi* of this cause. If experience furnish nothing to enlighten us upon this question, Did the universe come from the hand of an intelligent God, it furnishes as little to enlighten us upon the question, 'Did God create the universe in an instant, or did he do it in seven days, or did he do it in any other number of days that may be specified?' These are points which natural reason, exercising itself upon natural appearances, does not qualify us to know; and it were well if a maxim equally applicable to philosophers and to children, were to come in here for our future direction, 'that what we do not know we should be content to learn;' and if a revelation, bearing every evidence of authenticity, undertakes the office of informing us, it is our part cheerfully to acquiesce, and obediently to go along with it.

"On this principle, we refuse to concede the literal history of Moses, or to abandon it to the fanciful and ever-varying interpretations of philosophers. We fear that the slower revolution of the earth round her axis, is too gratuitous to make the admission of it at all consistent with the just rules of philosophizing; and there is, therefore, no other alternative left to us, but to take the history just as it stands. We leave it to geologists to

judge, whether our concluding observations allow them room enough for bringing about a consistency between the first chapter of Genesis and their theories. In the mean time, we assert that the history in this chapter maintains throughout an entire consistency with itself; a consistency which would be utterly violated, if we offered to allegorize the days, or to take them up in any other sense than that in which they obviously and literally present themselves. What shall we make of the institution of the Sabbath, if we surrender the Mosaic history of the creation? Is it to be conceived that the Jews would understand the description of Moses in any other sense than in the plain and obvious one? Is it to be admitted, that God would incorporate a falsehood in one of his commandments, or at least prefer a reason for the observance of it which was calculated to deceive, and had all the effect of a falsehood? We cannot but resist this laxity of interpretation, which, if suffered in one chapter of the Bible, may be carried to all of them, may unsettle the dearest articles of our faith, and throw a baleful uncertainty over the condition and the prospects of the species.

"We have heard it preferred as an impeachment against the consistency of the Mosaic account, that the day and night were made to succeed each other antecedently to the formation of the sun. This is very true; but it was not antecedent to the formation of light; it was not antecedent to the division of the light from the darkness; it may not have been antecedent to the formation of luminous matter; and though all this matter was not assembled into one body till the fourth day, it may have been separated and made to reside in so much greater abundance in one quarter of the heavens than in the other, as to have given rise to a region of light and a region of darkness. Such an arrangement would, with the revolution of the earth's axis, give rise to a day and a night. Enough for the purpose of making out this succession, if the light formed on the first day was

unequally dispersed over the surrounding expanse, though it was not till this light was fixed and concentrated in one mass, that the sun could be said to rule the day.

"And here let it be observed, that it does not fall upon the defenders of Moses to bring forward positive or specific proofs for the truth of any system reconcileable with his history, beyond the historical evidence of the history itself. A thousand systems may be devised, one of which only can be true, but each of which may be consistent with all the details of the book of Genesis. We cannot, and we do not offer any one of these systems as that which is to be positively received, but we offer them all as so many ways of disposing of the objections; and while upon us lies the bare task of proposing them, upon our antagonists lies the heavy work of overthrowing them all before they can set aside the direct testimony of the sacred historian, or assert that his account of the creation is contradicted by known appearances.

"We crave the attention of our readers to the above remark; and, satisfied that the more they think of it, the more will they be impressed with its justness, we spare ourselves the task of bestowing upon it any farther elucidation."

Note X. p. 77.

The conclusion of the same paper by Dr Chalmers, in the last note, we here insert, containing his suggestions of a pre-adamite world—suggestions, be it remembered, published twenty-three years ago.

"We conclude with adverting to the unanimity of geologists in one point,—the far superior antiquity of this globe to the commonly received date of it, as taken from the writings of Moses. What shall we make of this? We may feel a security as to those points in which they differ, and, confronting them with one

another, may remain safe and untouched between them. But when they agree, this security fails. There is no neutralization of authority among them as to the age of the world; and Cuvier, with his catastrophes and his epochs, leaves the popular opinion nearly as far behind him, as they who trace our present continent upward through an indefinite series of ancestors, and assign many millions of years to the existence of each generation.

"Should the phenomena compel us to assign a greater antiquity to the globe than to that work of days detailed in the book of Genesis, there is still one way of saving the credit of the literal history: The first creation of the earth and the heavens may have formed no part of that work. This took place at the *beginning*, and is described in the first verse of Genesis. It is not said when this *beginning* was. We know the general impression to be, that it was on the earlier part of the first day, and that the first act of creation formed part of the same day's work with the formation of light. We ask our readers to turn to that chapter, and to read the first five verses of it. Is there any forcing in the supposition that the first verse describes the primary act of creation, and leaves us at liberty to place it as far back as we may; that the first half of the second verse describes the state of the earth (which may already have existed for ages, and been the theatre of geological revolutions,) at the point of time anterior to the detailed operations of this chapter; and that the motion of the Spirit of God, described in the second clause of the second verse, was the commencement of these operations? In this case the creation of the light may have been the great and leading event of the first day; and Moses may be supposed to give us, not a history of the first formation of things, but of the formation of the present system; and as we have already proved the necessity of direct exercises of creative power to keep up the generations of living creatures, so Moses may, for any thing we

know, be giving us the full history of the last great interposition, and be describing the successive steps by which the mischiefs of the last catastrophe were repaired.

"I take a friend to see a field which belongs to me, and I give him a history of the way in which I managed it. In the beginning I enclosed that field. It was then in a completely wild and unbroken state. I pared it. This took up one week. I removed the great stones out of it. This took up another week. On the third week, I entered the plough into it: and thus, by describing the operations of each week, I may lay before him the successive steps by which I brought my field into cultivation. It does not strike me that there is any violence done to the above narrative, by the supposition that the enclosure of the field was a distinct and anterior thing to the first week's operation. The very description of its state after it was enclosed, is an interruption to the narrative of the operations, and leaves me at liberty to consider the work done after this description of the state of the field as the whole work of the first week. The enclosure of the field may have taken place one year, or even twenty years before the more detailed improvements were entered upon.

"The first clause of the second verse is just such another interruption; and it is remarkable, that there is no similar example of it in describing the work of any of the following days, so as to divide one part of the day's work from the other. It is true, that, in some cases, it is said that God saw it to be good; but there is no imperfection ascribed to any thing, as it resulted immediately from the creating power. It is always said to be good in that state in which it came directly out of his hand; and if, in the second verse, it is said of the earth, not that it was good, but that it was without form and void; this may look not like a description of its state immediately after it came out of the hand of God, but of its state after one of those catastrophes which

geologists assign to it. It is farther remarkable, that there is a unity in the work of each of the five days. The work of the second day relates only to the firmament; of the third day, to the separation of sea and land; of the fourth day, to the formation of the celestial bodies; of the fifth, to the creation of the sea; and of the sixth, to that of land animals. This unity of work would be violated on the first day, if the primary act of creation were to form part of it; and the uniformity is better kept up by separating the primary act from all the succeeding operations, and making the formation and division of light, the great and only work of the first day.

"The same observation may apply to all the celestial bodies that are visible to this world. The creation of the heavens may have taken place as far antecedently to the details of the first chapter of Genesis, as the creation of the earth. It is evident, however, that if the earth had been at some former period the fair residence of life, she had now become void and formless; and if the sun, and moon, and stars, at some former period had given light, that light had been extinguished. It is not our part to assign the cause of a catastrophe which carried so extensive a destruction along with it; but he were a bold theorist indeed, who could assert, that, in the wide chambers of immensity, no such cause is to be found. A thousand possibilities may be devised, each of which is consistent with the literal history of Moses; and though it is not incumbent on the one party to bring forward any one of these possibilities in the shape of a positive announcement, each of them must be overthrown by the other, before that history can be abandoned; and it will be found, that while the friends of the Bible are under no necessity to depart from the sober humility of the inductive spirit, the charge of unphilosophical temerity lies upon its opponents."

"Any curious information as to the structure of the earth ought not," says Bishop Sumner, "to be expected

by any one acquainted with the general character of the Mosaic records. There is nothing in them to gratify the curiosity or repress the researches of mankind, when brought in the progress of cultivation, to calculate the motions of the heavenly bodies, or speculate on the formation of the globe. The expressions of Moses are evidently accommodated to the first and familiar notions derived from the sensible appearances of the earth and heavens; and the absurdity of supposing that the literal interpretation of terms in Scripture ought to interfere with philosophical inquiry, would have been as generally forgotten as renounced, if the oppressors of Galileo had not found a place in history. The concessions, if they may be so called, of believers in Revelation on this point, have been amply remunerated by the sublime discoveries as to the prospective wisdom of the Creator, which have been gradually unfolded by the progressive improvements in astronomical knowledge. We may trust with the same confidence as to any future results from Geology, if this science should ever find its Newton, and break through the various obstacles peculiar to that study, which have hitherto precluded any general solution of its numerous and opposite phenomena.

"'All that I am concerned to establish is the unreasonableness of supposing that geological discoveries, so far as they have hitherto proceeded, are hostile to the Mosaic account of the creation. No rational naturalist would attempt to describe, either from the brief narration in Genesis or otherwise, the process by which our system was brought from confusion into a regular and habitable state. No rational theologian will direct his hostility against any theory, which, acknowledging the agency of the Creator, only attempts to point out the secondary instruments he has employed. It may be safely affirmed, that no geological theory has yet been proposed, which is not less reconcileable to ascertained facts and conflicting phenomena, than to the Mosaic history.

"'According to that history, we are bound to admit, that only one general destruction or revolution of the globe has taken place since the period of that creation which Moses records, and of which Adam and Eve were the first inhabitants. The certainty of one event of that kind, would appear from the discoveries of geologers, even if it were not declared by the sacred historian. *But we are not called upon to deny the possible existence of previous worlds, from the wreck of which our globe was organized, and the ruins of which are now furnishing matter to our curiosity.* The belief of their existence is indeed consistent with rational probability, and somewhat confirmed by the discoveries of astronomy, as to the plurality of worlds.'" *Records of Creation*, vol. ii. p. 356.

"In the creation of matter it is not related, 'God said let the heaven and the earth be,' as it is related of his other works which ensued; but simply and actually, 'God created the heaven and the earth,' so that the matter itself seems to have been, as it were, a *work of hand*, but the introduction of its form bears the style of a law or decree."—BACON, *De Augment. Scient.* Lib. I.

DR BUCKLAND'S OPINION.

We give the following quotation as comprehending the creed of Dr Buckland—the premises which he promises to *prove* to us in the subsequent parts of his work. We have looked in vain, however, for any such proofs, or even attempts at proof, throughout the remainder of his volumes, filled with most ingenious and highly amusing speculations, on the structure of fossil animals and plants.

"The Mosaic narrative commences with a declaration, that 'In the beginning God created the heaven and the earth.' These few first words of Genesis may be fairly appealed to by the geologist, as containing a brief statement of the creation of the material elements, at a

time distinctly preceding the operations of the first day. It is nowhere affirmed that God* created the heaven and the earth in the first day, but in *the beginning.* This beginning may have been an epoch, at an unmeasured distance, followed by periods of undefined duration, during which all the physical operations disclosed by geology were going on. The first verse of Genesis, therefore, seems explicitly to assert the creation of the universe, 'the heaven,' including the sideral systems, 'and the earth,' more especially specifying our own planet, as the subsequent scene of the operations of the six days about to be described. No information is given as to events which may have occurred upon this earth, unconnected with the history of man,† between the creation of its component matter recorded in the first verse, and the era at which its history is resumed in the second verse, nor is any limit fixed to the time, during which these intermediate events may have been going on. Millions of millions of years may have occupied the indefinite interval between the beginning, in which God created the heaven and the earth, and the evening or the commencement of the first day of the narrative.

"The second verse may describe the condition of the earth on the evening of this first day, for in the Jewish mode of computation, used by Moses, each day is reckoned

* "In six days the Lord made heaven and earth, the sea and all that *in* them is." Exodus, xx. 11.

The term *made* here, as comprehending the heavens or starry firmament, seems evidently synonymous with created. And that Moses designed it to be understood that the starry firmament, as well as the earth, had its origin by one continuous and uninterrupted act of creation, is farther evident by the summing up in verse 1, of chapter ii. "Thus the heavens and the earth were finished, *and all the host of them.*"

† "And the earth was without form and void, (or according to another translation, *invisible and unfurnished,*) and darkness was upon the face of the deep."

This description is evidently meant to include the condition of the earth from the moment of its first origination till the commencement of "the fitting it up," beginning with the evolution of light.

from the beginning of one evening, to the beginning of another evening. This first evening may be considered as the termination of the indefinite time which followed the primeval creation announced in the first verse, and as the commencement of the first of the six succeeding days, in which the earth was to be fitted up, and peopled in a manner fit for the reception of mankind. We have, in this second verse, a distinct mention of earth and waters, as already existing, and involved in darkness. Their condition also is described as a state of confusion and emptiness, (*tohu bohu,*) words which are usually interpreted by the vague and indefinite Greek term *chaos*, and which may be geologically considered as designating the wreck and ruins of a former world. At this intermediate point of time, the preceding undefined geological periods had terminated—a new series of events commenced, and the work of the first morning of this new creation was the calling forth of light from a temporary darkness, which had overspread the ruins of the ancient earth."—*Bridgewater Treatise on Geology*, vol i. p. 20—26.

In assuming this theory, the circumstances of the second verse seem to have come unexpectedly upon Dr Buckland in a somewhat similar manner as is related of John Kemble. This ingenious actor frequently indulged his fancy with shaping out new readings of Shakespeare, and made innovations on his own parts, sometimes without duly attending to their bearings on the general import of the play. In the character of Romeo, he fancied that, when about to purchase the poison, the utmost secrecy was intended by the author, and one night he accordingly stole gently to the door of the laboratory, and, instead of his usual sonorous exclamation, softly whispered, "What, ho, apothecary!" The apothecary, true to his part, entered, demanding, "Who calls so loud?" to the utter consternation of the tragedian, and the no small amusement of the house.

The Doctor, in the passage of his Bridgewater Treatise just quoted, comes out at once with his favourite emendation of the text of Moses, but immediately perceiving some incongruity in the verse that follows, he hurries on a destruction of his world, puts out the lights from his growing vegetables and sporting mastodons, and throws over all a "temporary darkness." Truly, if Moses is to be twisted and turned thus, we shall have sad work of it.

NOTE, p. 84.

FIGURATIVE INTERPRETATIONS OF MOSES.

The Rev. B. Powell, Professor of Geometry, Oxford, in his sermon on Revelation and Science, has the following remarks:—

"The sacred writers convey their doctrines through the medium of history, of fiction, of poetry, or of arguments, as well as direct precept. Their subject may involve incidental references to the facts of the natural world, and these they would, of course, present under that aspect in which they were commonly contemplated by the persons they were addressing. Their allusion would have failed in being a channel of communication, had they been led to depart from such a mode of representation. They might refer either to the sensible appearances of nature, or to the traditional belief respecting its mode of organization, or its subsequent revolutions. If we look at the actual case of the writings of Moses, it is surely, in every way, the most probable supposition that tradition had preserved some legendary memorials of primeval events, and that the origin of the world had been recorded in a poetical cosmogony. As introductory to the revelation of the law, Moses then put a RELIGIOUS APPLICATION upon such memorials *for the stronger sanction* of the enactments of that

law to the Israelites, and *adopted them* for the illustration of religious truths, and as the vehicles of moral instruction to the chosen people."

"The whole representation which Moses has given of the creation of the world," says Dr Knapp, "is as simple as possible, and such as doubtless was perfectly intelligible to those who lived in that infant age of the world, and is still so to men in common life. In the Bible, God speaks with men after the manner of men, and not in a language which is beyond the comprehension of most of them, as the learned would fain make it to be. Well, indeed, is it, for the great mass of mankind, that the learned were not consulted respecting the manner in which the Bible should be written.

"The general subject of this passage is indicated in the first verse of Genesis. This is then enlarged upon in the following verses, not to gratify the curiosity of scientific men, but to meet the wants of those who lived in the age in which it was written, and of common men in all ages. This amplification is entirely simple and popular; and the work of creation is here represented as a *six days' work*. It is to be considered as a picture in which God appears as a human workman, who accomplishes what he undertakes only by piecemeal, and on each successive day lays out and performs a separate portion of his business. By such a representation the notion of the creation is made easy to every mind; and common people seeing it so distinctly portrayed, can form some distinct conceptions concerning it, and read or hear the account of it with interest.

"If we would form a clear and distinct notion of this whole description of the creation, we must conceive of six separate *pictures*, in which this great work is represented in each successive stage of its progress towards completion; and as the performance of the painter, though it must have natural truth as its foundation, must not be considered or judged of as a delineation of

mathematical or scientific accuracy, so neither must this pictorial representation of the creation be regarded as literally and exactly true.

"The hypothesis of modern naturalists respecting the *material* of our globe, can neither be confirmed nor refuted from the writings of Moses. Which of all those which have been suggested is true, whether that of Whiston, who supposes the earth to be formed from a comet — that of Leibnitz, who makes it a sun burnt out —that of Buffon, according to whom all the heavenly bodies are fragments, broken off from the body of the sun by the concussion of a comet—or that of Wideburg, who supposes the earth to have been originally a *spot on the sun*—must be determined on other grounds than the testimony of Moses.

"All these learned speculations and inquiries respecting the material of the earth, &c. lie beyond the object and sphere of Moses; and any of these hypotheses of the naturalist may be adopted or rejected, the Mosaic geogony notwithstanding."—*Knapp's Lectures on Christian Theology*, vol. i. pp. 355, 356, and 360.

Note XI. p. 86.

THE FIRST FOUR DAYS OF CREATION.

Some more acute and more industrious still,
Contrive creation, travel nature up
To the sharp peak of her sublimest heights,
And tell us whence the stars!

Cowper.

To those who *will* form cosmogonies, and think it a pity to lose the new discoveries in nebular astronomy, without applying them to some useful purpose, it may be suggested that the chaotic state of the earth alluded to in the second verse of Genesis, and the four first

days of creation, may have occurred while the earth and our planetary system were yet in a nebulous state, and dependent upon and revolving round some other greater centre. That as yet the earth and the other planets did not revolve round the sun; but along with a slow orbital movement common to the whole, the earth also performed a revolution round its axis, correspondent to the measurement of a day and night, but of a much greater length than that of the days subsequently established. That, in this period, land, and ocean, and the atmosphere were formed; and towards the close of it, when the earth was fully prepared, the creation of vegetables took place. Immediately on this occurrence, the planetary system, as it at present exists, became established,—the sun became the centre of attraction, of light and heat, the moon had her circuit assigned her round the earth, and the other planets theirs round the central luminary. On the fifth morning that dawned on the now green earth, animals were created, and on the sixth day, man. Previous to the third day it had not rained, but a dew or vapour went up from the earth. Supposing that the primary mountains were elevated by igneous actions, the whole surface of the newly formed dry land must have been in a heated state, and from Mr Daniel's exposition of the condition of the atmosphere under an unequal elevation of temperature, this universal vapour is precisely what was to be looked for. One cannot but feel pleased with such coincidences, even though we are not assured of the facts on which they are built; and thus Mr Daniel expresses himself:—

"In the Mosaical account of the creation, the question has been asked, How is it that light is said to have been created in the first day, and day and night to have succeeded each other when the sun is described as not having been produced till the fourth day. The sceptic presumptuously replies, This is a palpable contradiction, and the history that propounds it must be false. But

Moses records, that God created, on the first day, the earth covered with water, and did not, till its second revolution upon its axis, call the firmament into existence. Now, one result of the previous inquiry has been, that a sphere, unequally heated, and covered with water, must be enveloped in an atmosphere of steam which would necessarily be turbid in its whole depth with precipitating moisture. The exposure of such a sphere to the orb of day would produce illumination upon it, that dispersed and equal light which now penetrates in a cloudy day, and which, indeed, is 'good,' but the glorious source of light could not have been visible from its surface. On the second day, the permanently elastic fluid was produced, and we have seen that the natural consequences of this mixture of gaseous matter, with vapour, must have been that the waters would begin to collect above the firmament, and divide themselves from the waters which were below the firmament. The clouds would thus be confined to definite plains of precipitation, and exposed to the influence of the winds and still invisible sun. The gathering together of the waters on the third day, and appearance of dry land, would present a greater heating surface, and a less surface of evaporation; and the atmosphere, during this revolution, would let fall its excess of condensed moisture; and upon the fourth day, it would appear probable even to our short-sighted philosophy, that the sun would be enabled to dissipate the still remaining mists, and burst forth with splendour upon the vegetating surface," &c.—*Daniel's Meteorological Essays*, p. 132. 2d Edition.

Plate III. *a* represents the supposed nebular condition of the planetary system; fig. 1, The first condition of the sphere of the globe; 2, The formation of the atmosphere; 3, The formation of dry land; 4, The earth and the other planets assuming their orbits round the sun.

PLATE III.

1 2 3

Note XII. p. 88.

For a description of the sites and remains of Babylon, Nineveh, &c. see Dr Keith on the Prophecies.

About the commencement of the Christian era, all traces of these ancient cities seem to have been lost, but recent travellers have discovered along the banks of the Tigris extensive ruins and mounds of earth, with vaults and caverns, all indicative of the former extent which Nineveh, the capital of the great Assyrian empire, is reported to have been—a city stretching 60 miles in circumference, defended by a wall of 100 feet, and 1300 towers of 200 feet in height.

Note XIII. p. 92.

Josephus says, that, during the twelve months of the prevalence of the deluge, "God changed the continent into sea." Philo, a Jew, who lived thiry years, B. C. writing on the same subject, perhaps partly from tradition and partly from his own conceptions of the Mosaic narrative, thus somewhat poetically says,—"The vast ocean being raised to an height which it had never before attained, rushed with a sudden inroad upon the islands and continents. The springs, rivers, and cataracts, confusedly mingling their streams, contributed to elevate the waters. Neither was the air quiet: dense and continuous clouds covered the whole heavens, violent hurricanes, thunders and lightnings, were blended with unintermitting torrents of rain; so that it seemed as if all parts of the universe were resolving themselves into the single element of water, until the fluid mass, having at length accumulated from the waters from above and from below, not only the lower lands, but even the

summits of the highest mountains, were submerged and disappeared. For every part of the earth sunk beneath the water, and the entire and perfect system of the world became (what it is not lawful either to speak or think) mutilated and deformed by a vast amputation." *Philo de Abrahamo.*

Note XIV. p. 96.

"*Cataclysmi* universalis certa rudera ego nondum attigi quosque penetravi minus etiam veram *terram Adamaticum*, sed ubique vidi factas ex equoræ terras, et in his mera rudera longinque sensim prœterlapsi œvi." *Linnœus, Syst. Nat.*

Dr Fleming thus writes,—"The simple narrative of Moses permits me to believe that the waters rose upon the earth by degrees and returned by degrees—that means were employed by the author of the calamity to preserve pairs of the land animals—that the flood exhibited no violent impetuosity, neither displacing the soil nor the vegetable tribes which it supported, nor rendering the ground unfit for the cultivation of the vine. With this conviction in my mind, I am not prepared to witness in nature any remaining marks of the catastrophe, and I feel my respect for the authority of revelation heightened, when I see, in the present surface, no memorials of the event. On the other hand, had I witnessed every valley and gravel bed—nay, every fossil bone—attesting the ravages of the dreadful scene, I would have been puzzled to account for the unexpected difficulties, and might have been induced to question the accuracy of Moses as an historian, or the claims of the Book of Genesis to occupy its present place in the sacred record."

"If the geological creeds of Baron Cuvier and Professor Buckland, be established as true in science, then must

the Book of Genesis be blotted out of the records of inspiration."—*Edin. Philosoph. Journal,* vol. xiv.

"I am of opinion, then, with M. De Luc and M. Dolomieu, that if there is any circumstance thoroughly established in geology, it is, that the crust of our globe has been subjected to a great and sudden revolution, the epoch of which cannot be dated much farther back than five or six thousand years ago; that this revolution had buried all the countries which were before inhabited by men and by the other animals that are now best known; that the same revolution had laid dry the bed of the last ocean which now forms all the countries at present inhabited—that the small number of individuals of men and other animals that escaped from the effects of that great revolution, have since propagated and spread over the lands then newly laid dry, and consequently that the human race has only resumed a progressive state of improvement since that epoch, by forming established societies, raising monuments, collecting natural facts, and constructing systems of science and of learning." Cuvier, *Ossmens Fossils,* tom. 1.

"The evidence which I have collected in my Reliquiæ Diluvianæ (1823) shews, that one of the last great physical events that have affected the surface of our globe was a violent inundation, which overwhelmed great part of the nothern hemisphere, and that this event was followed by the sudden disappearance of a large number of the species of terrestrial quadrupeds, which had inhabited these regions in the period immediately preceding it. I also ventured to apply the name *diluvium* to the superficial beds of gravel, clay, and sand, which appear to have been produced by this great irruption of water.

"The description of the facts that form the evidence presented in this volume is kept distinct from the question of the identity of the event attested by them, with any deluge recorded in history. Discoveries that have

been made since the publication of this work shew that many of the animals there described existed during more than one geological period preceding the catastrophe by which they were extirpated. Hence it seems more probable that the event in question was the last of the many geological revolutions that have been produced by violent eruptions of water, rather than the comparatively tranquil inundation described in the inspired narrative." — DR BUCKLAND'S *Bridgewater Treatise*, note, p. 95, vol. i.

Mr Greenough, too, after having borrowed the tail of Whiston's comet to produce his deluge, (1820) publicly renounces his belief in any general catastrophe in his address to the Geological Society, 1836.

In alluding to these changes of opinion, we by no means presume to hold them up to censure. The avowal of them, on the contrary, indicates a true nobleness of mind. We merely point them out as instances of the vacillating nature of geological theories; and, it may be, the progressive tendency of science, where every new step is but the correction of an old error.

The idea of the destruction of the antidiluvian continents has been objected to from the enumeration in Genesis, ii. 11—14, of the Euphrates and other three rivers still existing in Asia. Now, this very description in Genesis shews, that the "river which went out of Eden, and was parted, *and became into four heads*," could not apply to any known existing river, nor, in the most remote degree, to the Euphrates, the Heddekel, or Tigris, &c. because these latter take their rise from distinct sources, not from one common head. These names, probably of antediluvian rivers, must have been applied by the descendants of Noah to those of the new continents: or the four verses may have been added as a marginal note to the original text of Genesis. Marginal notes of this kind, ascertained to exist in the most ancient MSS. have been incorporated into the holy text, or, at least, there are strong grounds for presuming so,

however alarming and perplexing such circumstances may be to the sincere believer.

See an exposition of a marginal note of this kind introduced into the Gospel of St John, v. 1—6, in Granvill Penn's "Mineral and Mosaical Geology."

The deluge is alluded to in the following places in Scripture: — Isaiah, liv. 9; Ezekiel, xiv. 14, 20; Matthew, xxiv. 37, 39; Luke, xvii. 26, 27; 1 Peter, iii. 20; 2 Peter, ii. 5, and iii. 6; Hebrews, xi. 7.

NOTE XV. p. 98.

CHRONOLOGICAL EPOCHS OF THE WORLD.

"The period from the Creation to the Deluge, according to the Hebrew text, is . . . . 1656 years.
Samaritan, ... 1307
Septuagint, ... 2242

The era of Moses, according to Usher, *i. e.* the length of his life, was from 1572 to 1452, before the Christian era. The era of the Exodus Usher makes 1492 B.C.

The era of the Exodus, according to Dr Hales, calculating also by the Hebrew text, was 1648 B.C. or 156 years earlier than Usher makes it.

The period from the deluge to the present time is one of the most controverted points in chronology. Dr Hales (Analysis of Ancient History) gives a table of 127 discrepant statements, varying between 6984 and 3616 years B.C. for the date of the Creation. The Jews, upon the data of their own Hebrew Scriptures, give the year 3760 B.C. for the Creation. Archbishop Usher, upon the *very same data*, (*i. e.* the Hebrew text,) makes it 4004. Jackson and Hales, (the two most approved modern chronologists,) calculating upon the Septuagint data, make it, respectively, 5426 and 5411

B.C. Josephus, the Jewish historian, makes it 5402; or rather, to speak correctly, this is the calculation made upon his data; for the only calculation he makes himself is of the period between the Creation and the Deluge, which he states to be 2256 years. (Antiquities, chap. iii.)

None of the texts of Scripture, Hebrew, Greek, or Samaritan, exhibits any system of chronology. They merely narrate certain events, giving the lengths of the patriarchal generations, and of the reigns of the kings of Judah; and it is upon these particulars chiefly that chronologists have formed their systems. The grand points of difference between the texts are with respect to the lengths of the patriarchal generations, the nature of which difference may be seen at once from the following table, wherein it is shewn, that the period between the Creation and the Flood is made up of the sum of the differences between the birth of one patriarch and that of his son. The words of Scripture run thus: — "Adam lived an hundred and thirty years and begat Seth; Seth lived an hundred and five years and begat Enos;" and so forth.

	GENERATIONS.			RESIDUES.			LENGTH OF LIFE.		
	Heb.	Sam.	Sept.	Heb.	Sam.	Sept.	Heb.	Sam.	Sept.
Adam	130	130	230	800	800	700	930	930	930
Seth	105	105	205	807	807	707	912	912	912
Enos	90	90	190	815	815	715	905	905	905
Cainan	70	70	170	840	840	740	910	910	910
Malaleel	65	65	165	830	830	730	895	895	895
Jared	162	62	162	800	785	800	962	847	962
Enoch	65	65	165	300	300	200	365	365	365
Methuselah	187	67	167	782	653	802	969	720	969
Lamech	182	53	188	595	600	565	777	653	753
Noah	600	600	600						
	1656	1307	2242						

The principle is obvious: the Septuagint makes the length of some generations just 100 years longer than

the Hebrew; the Samaritan generally corresponds with the latter, but in three cases is different. Josephus agrees with the Septuagint in all except the generations of Methuselah and Lamech, which he makes 187 and 182, therein agreeing with the Hebrew. The discrepancies of the Samaritan text cannot be accounted for or explained.

A similar principle of difference runs through the generations of the postdiluvian patriarchs between Noah and Abraham, occasioning a difference of nearly eight hundred years between the Hebrew and the Septuagint, the latter having also an additional patriarch of the name of Cainan who is wanting in the Hebrew text, but is, nevertheless, mentioned by St Luke in his genealogy of our Saviour. There is every reason to think, that the two texts agreed precisely at the time of, or shortly preceding, the birth of Christ. Prior to his advent, the Jews were deeply impressed with the notion that the Messiah was to appear at the end of the sixth millennium of the world's age, and that his reign on earth would endure for another millennium, thus making the length of the world's existence to consist of seven millennial days, corresponding analogically with the *seven natural* days of creation. So far from any discrepancies being then observed in the Septuagint version, it was held by the Jews themselves in the highest esteem, and was even believed to have been made by divine inspiration. St Luke copies his genealogy from it; and Josephus, who lived in the same age, and who professes to have taken his materials from the *Hebrew* sacred books, agrees with it in giving the *long* generations of the patriarchs. It was only after their disappointment, with respect to the non-arrival of the Messiah, and in consequence of the appeals made by the Christians to the Septuagint version, as confirmatory of the new doctrine, that the Jews began to have an aversion for it. At length their hatred induced them to prepare a new Greek version of their own, and to

solemnly curse the Septuagint. Their new version corresponded with the Hebrew text; but it is alleged, and there is the strongest grounds for believing the charge, that they purposely altered the sacred text in order to disprove the Christian references, and particularly the patriarchal generation, in order to extend the millennial periods to a more distant futurity, and thus defeat the proof of Christ's messiahship, based upon the *fact* of his having actually arrived at the very time he was expected by themselves, namely, near the end of the sixth millennium. This vitiation of the text must have taken place about A. D. 130. The Septuagint, however, still remained the standard *Christian* Bible till the era of the Reformation, when the Reformers, in order to depart as widely as possible from every thing Popish, discarded it, and began to prefer the Hebrew, without ever troubling themselves to inquire whether it was or was not more genuine than its rival. Some of them even were so absurd as to assume that it had been divinely preserved immaculate, without a shadow of change or error.

With respect to the periods or lengths of the days, months, and years, mentioned by Moses, in his antediluvian history, nothing certain is known. Many conjectures have been hazarded by divines and chronologists, but to no purpose; for Moses himself gives no definition of his terms, and there is nobody else from whom we can learn what he has left unexplained. The word rendered *day* in Genesis, chap. i. some critics would make out to mean, not a natural day, of twenty-four hours, as at present, but an *indefinite time;* but Moses certainly never even hints at such an interpretation, or gives the smallest reason, in any part of his writings, to suppose that he meant any other than solar or natural days. The Septuagint renders the Hebrew word, (yom,) by the common Greek, ἡμερά. Josephus speaks of them as natural days, and nobody, I believe, ever doubted this till geological theories were found to be inconsistent

with the short Mosaic periods. The months of Moses were lunar, running from one new moon to another, and his years consisted of twelve months, of thirty days, or three hundred and sixty days. This, however, is, like every thing else relating to these early times, not expressly recorded, only a conjecture; and it is just as probable that his years were lunar, or three hundred and fifty-four days, like those of the later Jews."

I have been favoured with the above concise statement from my friend, James Laurie, Esq.; see also Bishop Russel's Sacred and Profane History, vol. I. chap. I.

EXPLANATION OF PLATE IV.

Fig. 1.

The reader is requested to compare Dr Buckland's section of the strata of the earth given in his Bridgewater Treatise, with Mr Conybeare's actual section in the first volume of the Transactions of the British Association for the Advancement of Science.

Dr Buckland's section is avowedly fanciful; and if he constructs theories for the *mind*, there is no reason why he may not delineate pictorial theories to the eye also. *In* the accompanying sketch, fig. 1. the actual *proportion* which the elevation of the stratified rocks and the highest mountains bear to the whole contents of the sphere of the globe is represented.

The mean diameter of the earth is estimated at 7911.73 miles. Supposing the extreme height of the atmosphere to be 45 to 50 miles, this would amount to about one-eightieth part of the semidiameter. The highest mountains on the globe do not exceed five miles and a half, or about one-ninth part of the height of the atmosphere. The extreme depth of the ocean may be reckoned at five and a half miles; so that the waving lines on the portion of the earth's circumference represented in the figure, will shew the irregularities caused on the surface by the elevations and depressions comprised within ten or eleven miles of perpendicular depth. The mean average elevation of the strata above the sea level becomes, in this diagram, scarcely perceptible. The first idea of a somewhat similar diagram originated with M. de la Beche.—*Geological Views and Sections.*

Fig. 2.

Represents a general view of a section of England, from Cumberland to Sussex, and is referred to page 18.

Fig 1

Fig 2

Cumberland
Derbyshire
Coal
Lancashire
Yorkshire
TRIASSIC FORMATION
CARBONIFEROUS FORMATION

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